

# **The Second World Congress on WILDERNESS MEDICINE**

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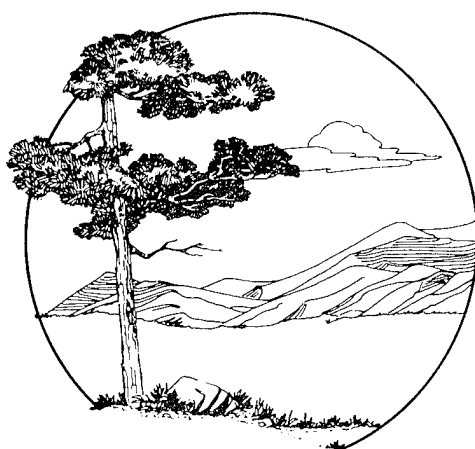
*The Wilderness Medical Society*

in association with

**INTERNATIONAL SOCIETY OF TRAVEL MEDICINE**

and

**INTERNATIONAL SOCIETY FOR MOUNTAIN MEDICINE**



**August 8-12, 1995  
Aspen, Colorado**

19951024 019

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COOPERATIVE AGREEMENT NUMBER: DAMD17-95-1-5072

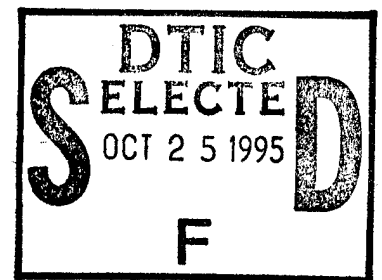
TITLE: Second World Congress on Wilderness Medicine

PRINCIPAL INVESTIGATOR(S): Ken Zafren, M.D.

CONTRACTING ORGANIZATION: Wilderness Medical Society  
Indianapolis, Indiana 46206

REPORT DATE: August 1995

TYPE OF REPORT: Final Proceedings



PREPARED FOR: U.S. Army Medical Research and Materiel Command  
Fort Detrick, Frederick, Maryland 21702-5012

DISTRIBUTION STATEMENT: Approved for public release;  
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REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE August 1995	3. REPORT TYPE AND DATES COVERED Final Proceedings (25 Sep 95 - 31 Dec 95)		
4. TITLE AND SUBTITLE Second World Congress on Wilderness Medicine		5. FUNDING NUMBERS DAMD17-95-1-5072		
6. AUTHOR(S) Ken Zafren, M.D.				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Wilderness Medical Society Indianapolis, Indiana 46206		8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Medical Research and Materiel Command Fort Detrick, Maryland 21702-5012		10. SPONSORING/MONITORING AGENCY REPORT NUMBER		
11. SUPPLEMENTARY NOTES Date of Conference - August 8-12, Aspen, CO				
12a. DISTRIBUTION/AVAILABILITY STATEMENT  Approved for public release; distribution unlimited		12b. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 words)				
14. SUBJECT TERMS Conference; Wilderness; Medicine			15. NUMBER OF PAGES 566	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT Unlimited	

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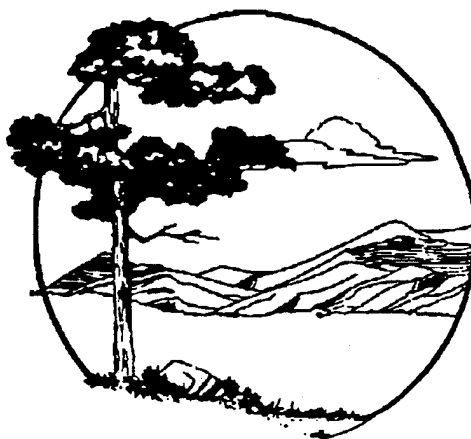
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Unannounced <input type="checkbox"/>	
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**August 8-12, 1995  
Aspen, Colorado**

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*The tendency nowadays to wander in wilderness is delightful to see. Thousands of tired, nerve-shaken, over-civilized people are beginning to find out that going to the mountains is going home; that wilderness is a necessity; and that mountain parks and reservations are useful not only as fountains of timber and irrigating rivers, but as fountains of life. Awakening from the stupefying effects of the vice of over-industry and the deadly apathy of luxury, they are trying as best they can to mix and enrich their own little ongoings with those of Nature, and to get rid of rust and disease.*

John Muir

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Program Co-Director

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Blair Erb, MD

Lori Hart, RN, PNP

Eric Johnson, MD

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Bruce Paton, MD

David Shlim, MD

# Wilderness Medical Society

August 7, 1995

Welcome to the Second World Congress on Wilderness Medicine! This congress is presented by the Wilderness Medical Society in association with the International Society for Mountain Medicine and the International Society of Travel Medicine.

You are about to participate in an exciting event that will happen only once every four years and has only happened once before. For the first time, we have affiliated with two preeminent scientific societies whose interests are closely allied to those of the Wilderness Medical Society. We have done our best to respond to requests of our members. We have planned a shorter, more concentrated meeting, but we are still offering the most workshops ever offered at a wilderness medicine conference, including our own previous annual meetings.

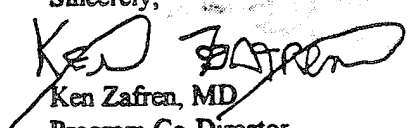
Although we have emphasized mountain medicine and adventure travel, we have tried to cover a wide range of wilderness topics with an international emphasis. The evening programs should compliment the daytime medical sessions. We especially encourage all who are interested to attend the open forums which will be given as afternoon workshop sessions on search and rescue, wilderness medicine education of the public, and the feasibility of on-going efforts among organizations.


We hope you will take time to meet our faculty members and other participants during the conference. An informal atmosphere has always been one of the hallmarks of our meetings, making it easy to make new friends and acquaintances from around the world.

We would also like to welcome you to Aspen. We choose Aspen because of its beautiful natural setting and variety of outdoor recreational opportunities. We hope you will find time before, after, and to some extent, during the meeting to enjoy some of these opportunities.

So, enjoy the meeting and enjoy Aspen!

Sincerely,

  
Ken Zafren, MD  
Program Co-Director

  
Peter Hackett, MD  
Program Co-Director

# Faculty

## Howard Backer, MD

Past President and Board Member, Wilderness Medical Society; Emergency and Sports Medicine Physician, Kaiser Permanente; Piedmont, CA

## Warren Bowman, MD

President, Wilderness Medical Society; National Medical Advisor, National Ski Patrol; Clinical Associate Professor of Medicine, University of Washington; Billings Clinic; Billings, MT

## Dickie Brown, NRWMT-B-IV

Instructor/Coordinator, Wilderness Professional Training; Crested Butte, CO

## William Casey

Founder, Chairman and CEO, Phoenix Alliance, Inc.; St Paul, MN

## Charles Clarke, MD

Director, UIAA Mountain Medicine Centre, St. Bartholomew's Hospital, London, England

## Bill Clem, MD

Specialist in Emergency and Hyperbaric Medicine; National Medical Advisor, Mountain Rescue Association; Instructor in Technical Rescue, National Park Service; U.S. Representative, International Commission on Alpine Rescue; Idaho Springs, CO

## Lily Conrad, MD, PhD, FACEP

Board Member, Wilderness Medical Society; President, Colorado Chapter of ACEP; Emergency Physician, Rose Medical Center, Denver, CO; and Lake Hospital, Yellowstone National Park; Evergreen, CO

## Anne Dickison, MD

Director, Pediatric Intensive Care Unit; Director Pediatric Transport System, Assistant Professor of Anesthesia and Pediatrics, Dartmouth-Hitchcock Medical Center; Etna, NH

## Bruno Durrer, MD

Board Member, International Society of Mountain Medicine and Medical Commission of the UIAA; Member, Medical Commission of ICAR; General Practitioner in the Eiger mountaineering region; Lauterbrunnen, Switzerland

## Blair D. Erb, MD

Past President, Wilderness Medical Society; Clinical Professor, Preventive Medicine, University of Tennessee; author, American Heart Association *"Standards for Cardiovascular Exercise Treatment Programs,"* Jackson, TN

## Peter Hackett, MD

Director, Denali Medical Research Project; Medical Control, Denali National Park Mountaineering Rangers; Affiliate Assoc. Professor, University of Washington and University of Alaska; Emergency Physician; Anchorage, AK

## Murray Hamlet, DVM

Director, Research Programs and Operations Division at the US Army Research Institute of Environmental Medicine; Natick, MA

## Brian Horner

Owner/Chief Instructor, LTR Training Systems; Anchorage, AK

## Herbert N. Hultgren, MD

Professor of Medicine Emeritus, Stanford Medical School; Staff Cardiologist, Palo Alto VA Medical Center; Member, Medical Committee, American Alpine Club; Stanford, CA

## Jack Ives, PhD

Professor of Mountain Geoecology, Division of Environmental Studies, University of California, Davis; President and Founder, International Mountain Society; Research Coordinator, United Nations University Program on Mountain Ecology and Sustainable Development; Davis, CA

## Eric Johnson, MD

Emergency Physician; Clinical faculty, University of Washington/Family Practice Residency of Idaho; Assistant Director, Rocky Mountain Center for Wilderness Medicine; Advanced Nav I Diver; Boise, ID

## Elaine Jong, MD

Clinical Professor of Medicine, University of Washington; Past President, American Committee Clinical Tropical Medicine & Traveler's Health; Founding Editor, *The Travel Medicine Advisor*; Seattle, WA

## Bengt Kayser, MD, PhD

Exercise physiologist with special interest in exercise at high altitude; climbing expedition physician; research and teaching at the Universite de Geneve; Geneva, Switzerland

## Jay Keystone, MD, FRCPC

Director, Tropical Disease Unit, The Toronto Hospital; Professor of Medicine, University of Toronto; President-Elect, International Society of Travel Medicine; Toronto, Ontario, Canada

## Carolyn Langer, MD, JD, MPH

Instructor in Occupational Medicine, Harvard School of Public Health, Lecturer on Occupational Health Law, Harvard Educational Resource Center, Brookline, MA

## Hans O. Lobel, MD

Medical Epidemiologist, Malaria Unit, Centers for Disease Control; Secretary-Treasurer, International Society of Travel Medicine; Atlanta, GA

## Steve Lyons, NREMT-P

President, Wilderness Professional Training; currently volunteers as a Paramedic for the Fire Department, Professional Ski Patrol and the Search and Rescue Team; Crested Butte, CO

## Chris Moore

Chairman, WMS Environmental Council; Emergency/Family/Sports Medicine Physician; Delegate to Earth Summit in Rio, 1992 and Global Forum in Manchester, England, 1994; Lookout Mountain, TN

## Mountain Rescue Aspen

*Lori Hart, RN, PNP*, Liaison; Mountain Rescue Aspen (MRA) was founded in 1965. By national charter, it is made up entirely of volunteers. The team is recognized as one of the premier mountain rescue organizations in the region. Training is extensive and recertification of the entire team is required every five years. MRA's roster is made up of 45 men and women who reside in the Aspen area.

## NOLS

*Tod Schimelpfenig, EMT*, Liaison; National Outdoor Leadership School (NOLS) is a private, non-profit school based in Lander, Wyoming. Since its founding in 1965, the school has graduated over 30,000 students.

## Mel Otten, MD

Board Member, Wilderness Medical Society; Professor of Emergency Medicine, University of Cincinnati; Cincinnati, OH

## Bruce Paton, MD

President-Elect, Wilderness Medical Society; Clinical Professor of Surgery, University of Colorado; Board of Trustees, Colorado Outward Bound School; Denver, CO

## Steve Pehrson, MD

Emergency Physician, Utah Basin Medical Center, Roosevelt, Utah; Program Director, NASAR Wilderness Medicine Program

## Jean-Paul Richalet, MD

President, International Society for Mountain Medicine; Professor of Physiology, Faculty of Medicine; Director of French Scientific Expeditions to the Himalayas and Andes; Bobigny, France

## Ron Ruffing, MD

Assistant Professor of Emergency Medicine and Pediatrics, Tufts University; International Medical Corp., Emergency Medicine Project, Bosnia-Herzegovina; Boston, MA

## Aaron Sachs

Research Associate, Worldwatch Institute; Washington, DC

## Joseph Serra, MD

Team Physician, University of the Pacific; Orthopedic Surgeon; Stockton, CA

## David Shlim, MD

Medical Director, CIWEC Clinic; Medical Advisor, Himalayan Rescue Association; Member, Editorial Boards of *Journal of Wilderness Medicine* and *Journal of Travel Medicine*; Kathmandu, Nepal

## David Swersky, DMD

14 year member of Mountain Rescue Aspen; Dentist; Aspen, CO

## Carla Tomaszczyk, EMT-D

Assisted by Ted Bennett, Angela Eaton and Kelly Pontbriand, Search and Rescue Dogs of Colorado; Aspen, CO

## Eric A. Weiss, MD

Board Member, Wilderness Medical Society; Assistant Professor of Emergency Medicine, Associate Director of Trauma, Stanford University Medical Center; Medical Director, Stanford University Emergency Services Training Center; Redwood City, CA

## John B. West, MD, PhD, DSC, FRCP, FRACP

Professor of Medicine and Physiology, University of California, San Diego, CA; La Jolla, CA

## Ken Zafren, MD

Board Member, Wilderness Medical Society, Associate Medical Director (USA), Himalayan Rescue Association; Medical Advisor, Alaska Mountain Rescue Group; Emergency Physician; Anchorage, AK

## Stacy Zamudio, PhD

Senior Instructor, Dept. of Anesthesiology; Senior Instructor, Health and Behavioral Sciences Doctoral Program; University of Colorado; Denver, CO



# Program

## MONDAY, AUGUST 7, 1995

2:00-6:00 p.m. Registration ..... Salon Prefunction I

## TUESDAY, AUGUST 8, 1995

All Day Activities

1:00 - 5:00 p.m. Registration ..... Salon Prefunction I

6:00 - 7:30 p.m. Environmental Council ..... Salon I

*Dr. Moore*

7:30 - 8:30 p.m. Evening Presentation ..... Salon I

"Mountains and Mysteries"

*Dr. Zafren*

8:30 - 10:00 p.m. Dessert Reception ..... Salon II

## WEDNESDAY, AUGUST 9, 1995

7:00 - 8:00 a.m. Morning Refreshments ..... Salon II

8:00 - 8:15 a.m. Welcoming Remarks ..... Salon I

*Drs. Hackett & Zafren*

8:15 - 10:00 a.m. Research Abstracts ..... Salon I

10:00 - 10:30 a.m. Break ..... Salon II

10:30 - 12:00 p.m. Abstracts (Continued) ..... Salon I

12:00-1:30 p.m. Lunch (on your own)

1:30 - 1:50 p.m. Introduction - Warnings

in the Wilderness ..... Salon I

*Dr. Zafren*

1:50 - 2:35 p.m. Medico Legal Issues:

Duty to Warn ..... Salon I

*Dr. Langer*

2:35 - 3:20 p.m. Wild Animal Attacks ..... Salon I

*Dr. Conrad*

3:20 - 3:40 p.m. Break ..... Salon II

3:40 - 4:30 p.m. Environmental Refugees ..... Salon I

*Mr. Sachs*

4:45 - 6:15 p.m. Workshops

1. Issues of Rescue ..... Maroon Bells I

*Dr. Pehrson*

2. Duty to Care ..... Ashcroft

*Dr. Langer*

3. Surviving the Unexpected

Night Out ..... Off-Site

*Dr. Zafren*

4. International Medical

Relief: Is It For You? ..... Maroon Bells II

*Dr. Ruffing*

5. Decision Making in

Mountain Rescue: Case

Studies ..... Antero

*MRA*

6. Decision Making in Altitude

Illness: Case Studies ..... Independence

*Dr. Hackett*

7. Mountain Bike Safety ..... Off-Site,

*Dr. Conrad* (Salon I, back-up only)

8. Pain Management in the

Wilderness ..... Highlands

*Dr. Dickison*

9. Hunting Injuries ..... Salon I

*Dr. Otten*

10. Non-Freezing Cold Injuries ..... Pyramid

*Dr. Hamlet*

11. Human Rights and the

Environment ..... Capitol

*Mr. Sachs*

6:15 - 8:00 p.m. Dinner (on your own)

8:00 - 9:00 p.m. Evening Presentation

"Bosnia; Impact of Civil

War on Medical Care" ..... Salon I

*Dr. Ruffing*

## THURSDAY, AUGUST 10, 1995

7:00 - 8:00 a.m. Morning Refreshments ..... Salon II

8:00 - 8:10 a.m. Introduction to ISMM ..... Salon I

*Dr. Richalet*

8:10 - 9:00 a.m. Cerebral Etiology of AMS ..... Salon I

*Dr. Hackett*

9:00 - 9:50 a.m. Heart Disease and High Altitude ..... Salon I

*Dr. Hultgren*

9:50 - 10:20 a.m. Break ..... Salon II

10:20 - 11:10 a.m. Recent Advances in HAPE ..... Salon I

*Dr. West*

11:10 a.m. - 12:00 p.m. Limits of Performance ..... Salon I

*Dr. Kayser*

12:00 - 1:30 p.m. Lunch (on your own)

Concurrent Session A ..... Maroon Bells I & II

1:30 - 2:20 p.m. Natural Hazards

*Dr. Ives*

2:20 - 3:10 p.m. Recent Advances in

Avalanche Survival

*Dr. Durrer*

3:10 - 3:40 p.m. Break ..... Salon II

3:40 - 4:30 p.m. Canadian Mountain

Rescue: State of the Art

*Mr. Heshka*

Concurrent Session B ..... Salon I

1:30 - 2:20 p.m. High Altitude Hematology

*Dr. Richalet*

2:20 - 3:10 p.m. Diving at Altitude

*Dr. Johnson*

3:10 - 3:40 p.m. Break ..... Salon II

3:40 - 4:30 p.m. The Old, The Young and

The Unborn at Altitude

*Dr. Zamudio*

4:45 - 6:15 p.m. Workshops

8. Pain Management in the

Wilderness ..... Highlands

*Dr. Dickison*

12. Wilderness Medicine Education:

How to Reach the Public ..... Ashcroft

*Dr. Backer*

13. Frostbite ..... Salon I, Front Half

*Dr. Hamlet*

14. European Mountain Rescue:

State of the Art ..... Maroon Bells I

*Dr. Durrer*

15. Medical Problems of High

Altitude Residents ..... Maroon Bells II

*Dr. Zamudio*

16. Physiology of Altitude Training

For Sea-Level Competition ..... Pyramid

*Dr. Kayser*

17. Survival at Extreme Altitude ..... Aspen Room

*Dr. Clarke*

18. Advising Patients with

Heart Disease ..... Salon I, Back Half

*Dr. Hultgren*

19. Predicting High Altitude

Performance/Expedition Training ..... Antero

*Dr. Richalet*

20. Being an Expedition Doctor ..... Capitol

*Dr. Zafren*

21. Arctic Survival ..... Mill Street Club

*Mr. Horner*

22. Wilderness Wound

Management ..... Independence

*Dr. Otten*

6:15 - 8:00 p.m. Dinner (on your own)

8:00 - 9:00 p.m. Evening Presentation

"Preservation of Mountain

Environments" ..... Salon I

*Dr. Ives*

## FRIDAY, AUGUST 11, 1995

7:00 - 8:00 a.m.	Morning Refreshments .....	Salon II
8:00 - 10:00 a.m.	<b>Workshops-</b>	
23.	Land Navigation for Search and Rescue .....	Maroon Bells I
	<i>MRA</i>	
24.	Land Navigation for Search and Rescue .....	Independence
	<i>Dr. Otten</i>	
25.	Improvised Airway Management .....	Ashcroft
	<i>Dr. Dickson</i>	
26.	Cold Weather Survival .....	Off-Site
	<i>Dr. Bowman</i>	
27.	Air Crash Survival .....	Mill Street Club
	<i>Mr. Horner</i>	
28.	Field Water Disinfection .....	Highlands
	<i>Dr. Backer</i>	
29.	Leave No Trace: How Not to be a Disease Vector .....	Off-Site
	<i>NOLS</i>	
30.	What's New in Diving Medicine .....	Pyramid
	<i>Dr. Johnson</i>	
31.	Thoracic and Abdominal Injuries in the Field .....	Maroon Bells II
	<i>Dr. Paton</i>	
32.	SAR Dogs .....	Off-Site
	<i>Ms. Tomaszczyk, et. al.</i>	
33.	Mountain Rescue in U.S. Comparison of U.S., Canadian and European Techniques .....	Capitol
	<i>Dr. Clem</i>	
10:15 a.m. - 12:15 p.m.	<b>Workshops</b>	
23. & 24.	Continue;	
25. - 31.	Repeat	
34.	Human Performance in the Wilderness .....	Antero
	<i>Dr. Erb</i>	
35.	Soft Evac Systems .....	Capitol
	<i>Dr. Clem</i>	
12:15 - 1:30 p.m.	Lunch ( <i>on your own</i> )	
1:30 - 1:40 p.m.	Introduction to ISTM .....	Salon I
	<i>Dr. Keystone</i>	
1:40 - 2:25 p.m.	Ten Commandments of Third World Travel .....	Salon I
	<i>Dr. Keystone</i>	
2:25 - 3:10 p.m.	Protection Against Insects .....	Salon I
	<i>Dr. Jong</i>	
3:10 - 3:40 p.m.	Break .....	Salon II
3:40 - 4:30 p.m.	World Status of Malaria Prophylaxis .....	Salon I
	<i>Dr. Lobel</i>	
4:45 - 6:15 p.m.	<b>Workshops</b>	
21.	Arctic Survival .....	Independence
	<i>Mr. Horner</i>	
36.	Organizational Cooperation in Wilderness Medicine: Toward True Congress .....	Antero
	<i>Dr. Erb</i>	
37.	Arranging Medical Repatriation .....	Pyramid
	<i>Mr. Casey</i>	
38.	Fever Case Studies .....	Cancelled
	<i>Dr. Lobel</i>	
39.	Himalayan Rescue Association .....	Highlands
	<i>Dr. Zafren</i>	
40.	Skin Diseases .....	Maroon Bells II
	<i>Dr. Keystone</i>	
41.	STDs .....	Salon I, Front Half
	<i>Dr. Jong</i>	
42.	Decision Making in Altitude Illness .....	Maroon Bells I
	<i>Dr. Hackett</i>	
43.	Advanced Rescue Techniques .....	Off-Site
	<i>MRA</i>	

44.	Heat Emergencies .....	Mill Street Club
	<i>Dr. Weiss</i>	
45.	Accident Prevention in the Wilderness .....	Ashcroft
	<i>NOLS</i>	
46.	Wilderness Dental Emergencies .....	Capitol
	<i>Dr. Swersky</i>	
6:15-8:00 p.m.	Dinner ( <i>on your own</i> )	
8:00-9:00 p.m.	<b>Evening Presentation</b> .....	Salon I
	<i>"Dr. Zhivago Revisited: Health Care in Russia"</i>	
	<i>Mr. Horner</i>	

## SATURDAY, AUGUST 12, 1995

7:00-8:00 a.m.	Morning Refreshments .....	Salon II
8:00 - 10:00 a.m.	<b>Workshops</b>	
32.	SAR Dogs .....	Off-Site
	<i>Ms. Tomaszczyk, et. al.</i>	
47.	Basic Rescue Systems .....	Off-Site
	<i>Mr. Lyons &amp; Mr. Brown</i>	
48.	High Angle Rescue .....	Off-Site
	<i>MRA</i>	
49.	Desert Survival .....	Independence
	<i>Dr. Otten</i>	
50.	Dressing for Comfort in the Outdoors .....	Maroon Bells I
	<i>NOLS</i>	
51.	Innovations and Attitudes in Dive Safety .....	Ashcroft
	<i>Dr. Johnson</i>	
52.	Field Treatment of Hypothermia .....	Maroon Bells II
	<i>Dr. Paton</i>	
53.	Backcountry Fractures and Dislocations .....	Off-Site
	<i>Dr. Serra</i>	
54.	Medical Selection of Participants in Wilderness Ventures .....	Antero
	<i>Dr. Erb (one time only)</i>	
55.	Wilderness Medicine Improvisation .....	Off-Site
	<i>Dr. Weiss</i>	
56.	Blood on the Rocks: Helicopter Use in Non-Critical Mountain Rescue Operations .....	Capitol
	<i>Dr. Clem</i>	
57.	Immunizations .....	Pyramid
	<i>Dr. Shlim</i>	
10:15 a.m. - 12:15 p.m.	<b>Workshops</b>	
47. & 48.	Continue;	
49. - 53.	Repeat	
58.	Operating a Travel Medicine Clinic .....	Pyramid
	<i>Dr. Jong</i>	
59.	Improvised Techniques in Mountain Rescue .....	Off-Site
	<i>Drs. Clem &amp; Zafren</i>	
60.	Cold Water Near Drowning .....	Capitol
	<i>Dr. Weiss</i>	
12:15 - 1:30 p.m.	Lunch ( <i>on your own</i> )	
1:30 - 2:20 p.m.	Air Medical Evacuations .....	Salon I
	<i>Mr. Casey</i>	
2:20 - 3:10 p.m.	Diarrheal Illness .....	Salon I
	<i>Dr. Shlim</i>	
3:10 - 3:40 p.m.	Break .....	Salon II
3:40 - 4:30 p.m.	Travelers with Fever .....	Salon I
	<i>Dr. Keystone</i>	
4:30 - 5:20 p.m.	Travelers with Underlying Disease .....	Salon I
	<i>Dr. Jong</i>	
6:45 - 7:30 p.m.	Reception .....	Ballroom Prefunction
7:30 - 8:30 p.m.	Banquet .....	Salon I
8:30 - 10:00 p.m.	<b>Special Presentation</b> .....	Salon I

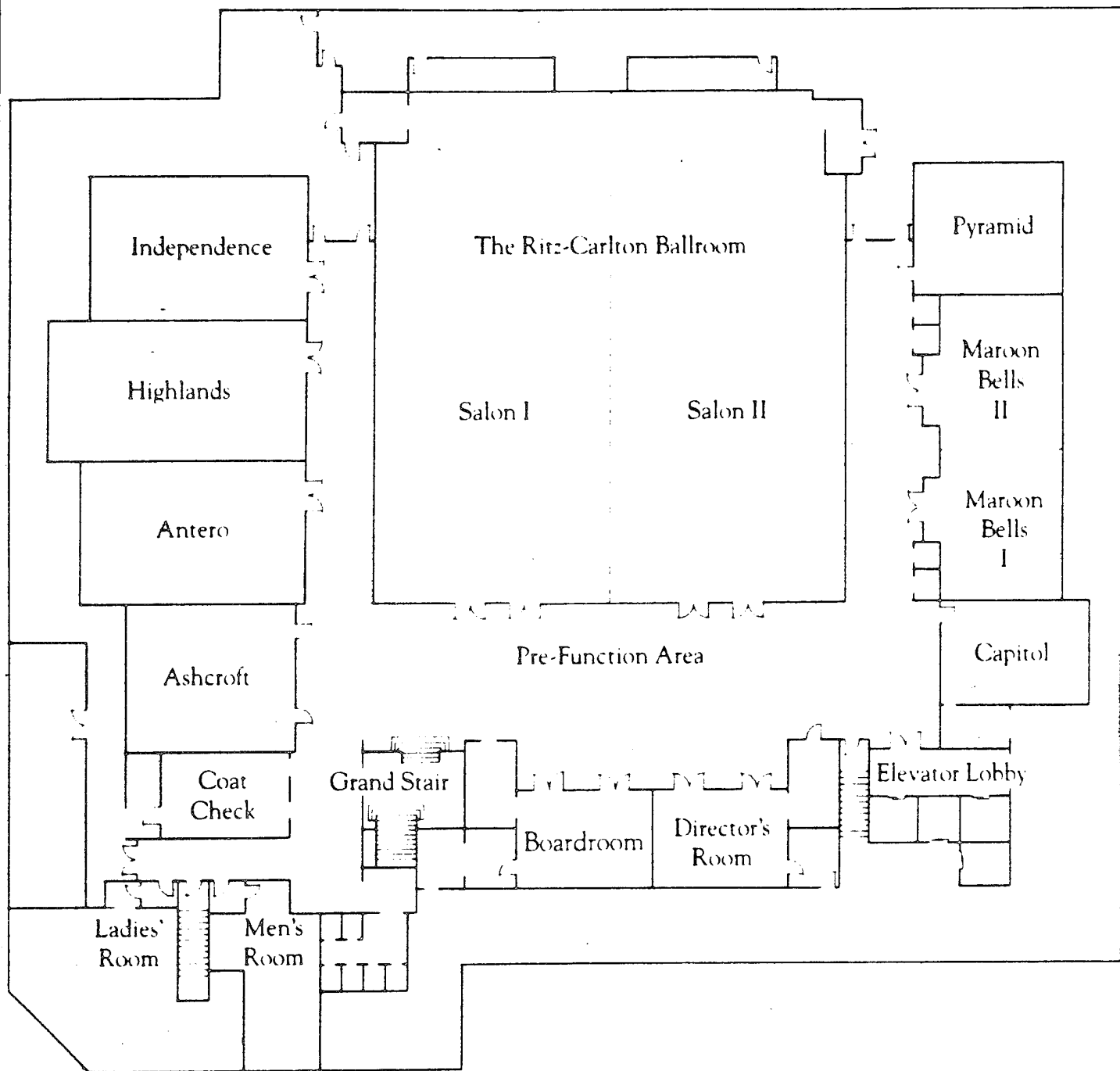
Wilderness Medical Society  
Second World Congress on Wilderness Medicine

Workshop Location Chart

Date	Name of Workshop	Location
Wed., Aug 9 4:45-6:15 pm	#1 Issues of Rescue	Maroon Bells I
	#2 Duty to Care	Ashcroft
	#3 Surviving Night Out	off-site
	#4 International Medical Relief	Maroon Bells II
	#5 Decision Making in Mtn Rescue	Antero
	#6 Decision Making in Alt. Illness	Independence
	#7 Mountain Bike Safety	Off-site, Salon I back-up only
	#8 Pain Mgmt in the Wilderness	Highlands
	#9 Hunting Injuries	Salon I
	#10 Non-Freezing Cold Injuries	Pyramid
Thursday, Aug 10 4:45-6:15 pm	#11 Human Rights/Environment	Capitol
	#8 Pain Mgmt in the Wilderness	Highlands
	#12 Wilderness Medicine Educ.	Ashcroft
	#13 Frostbite	Salon I, front half
	#14 European Mtn. Rescue	Maroon Bells I
	#15 Med Problems of High Alt. Res.	Maroon Bells II
	#16 Physiology Alt. Training	Pyramid
	#17 Survival at Extreme Altitude	Aspen Room
	#18 Advising Patients Heart Disease	Salon I, back half
	#19 Pred. High Alt. Performance	Antero
Friday , Aug 11 8:00-10:00 am	#20 Being an Expedition Doctor	Capitol
	#21 Arctic Survival	Mill Street Club
	#22 Wilderness Wound Mgmt.	Independence
	#23 Land Navigation for SAR	Maroon Bells I
	#24 Land Navigation for SAR	Independence
	#25 Improvised Airway Mgmt.	Ashcroft
	#26 Cold Weather Survival	off-site
	#27 Air Crash Survival	Mill Street Club
	#28 Field Water Disinfection	Highlands
	#29 Leave No Trace	off-site
10:15 am-12:15 pm	#30 What's New in Diving Medicine	Pyramid
	#31 Thoracic and Abdominal Injuries	Maroon Bells II
	#32 SAR Dogs	off-site
	#33 Mountain Rescue in the US	Capitol
	#25-31 repeat	
	#34 Human Performance	Antero
	#35 Soft Evac. Systems	Capitol
	#21 Arctic Survival	Independence
	#36 Organizational Cooperation	Antero
	#37 Arranging Medical Repatriation	Pyramid
4:45-6:15 pm	#38 cancelled	
	#39 Himalayan Rescue Association	Highlands

	#40 Skin Diseases	Maroon Bells II
	#41 STD's	Salon I front half
	#42 Decision Making in Altitude Illness	Maroon Bells I
	#43 Advanced Rescue Techniques	off-site
	#44 Heat Emergencies	Mill Street Club
	#45 Accident Prevention	Ashcroft
	#46 Wilderness Dental Emergencies	Capitol
Saturday, Aug. 12	#32 SAR Dogs	off-site
8:00-10:00 am	#47 Basic Rescue Systems	off-site
	#48 High Angle Rescue	off-site
	#49 Desert Survival	Independence
	#50 Dressing for Comfort	Maroon Bells I
	#51 Innovations/Attitudes Diving	Ashcroft
	#52 Field Treatment of Hypothermia	Maroon Bells II
	#53 Backcountry Fractures/Disloc.	off-site
	#54 Med Selec. Part. Wild. Ventures	Antero
	#55 Wilderness Med. Improvisation	off-site
	#56 Blood on the Rocks	Capitol
	#57 Immunizations	Pyramid
10:15 am-12:15 pm	#47 and #48 continue	
	#49-53 repeat	
	#58 Travel Med. Clinic	Pyramid
	#59 Improv. Tech. Mountain Rescue	off-site
	#60 Cold Water Near Drowning	Capitol

## THE RITZ-CARLTON ASPEN MEETING ROOMS



# *Wilderness Medical Society*

## **Second World Congress on Wilderness Medicine**

### **Meeting Schedule**

*Tuesday, August 8, 1995*

8:00 am - 4:00 pm	WMS Board of Directors	Highlands
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*Wednesday, August 9, 1995*

7:00 am - 8:00 am	Research Committee Nominations and Awards	Directors Room Board Room
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Noon-1:30 pm	Journal Editorial Board Conference Planning	Board Room Directors Room
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6:15 pm-7:00 pm	Publications Liaison	Board Room Directors Room
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*Thursday, August 10, 1995*

7:00 am - 8:00 am	Military Advisory Committee Communications Committee	Board Room Directors Room
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Noon-1:30 pm	Development Associate Member Task Force	Board Room Directors Room
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6:15 pm-7:00 pm	Finance By-Laws and Governance	Board Room Directors Room
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7:00 pm - 8:00 pm	Optional Board meeting time	
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*Friday, August 11, 1995*

7:00 am- 8:00 am	Regional Meetings Committee Marketing Committee	Board Room Directors Room
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Noon-1:30 pm	Member Services EMT Certification	Board Room Directors Room
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6:15 pm - 8:00 pm	Board Dinner with Committee reports	Independence
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## *NOTES*

# Second World Congress on Wilderness Medicine

## PERSONAL PROGRAM PLANNER

### TUESDAY, AUGUST 8

1:00 p.m. - 5:00 p.m. Registration  
6:00 p.m. - 7:30 p.m. Environmental Council  
7:30 p.m. - 8:30 p.m. Evening Presentation  
8:30 p.m. - 10:00 p.m. Dessert Reception

### WEDNESDAY, AUGUST 9

8:00 a.m. - 12:00 p.m. Research Abstracts  
1:30 p.m. - 4:30 p.m. General Session  
4:45 p.m. - 6:15 p.m. Workshop:  
Number \_\_\_\_\_ Title \_\_\_\_\_ Location \_\_\_\_\_  
8:00 p.m. - 9:00 p.m. Evening Presentation

### THURSDAY, AUGUST 10

8:00 a.m. - 12:00 p.m. General Session  
Concurrent Sessions:  
A: Title \_\_\_\_\_ Room \_\_\_\_\_ B: Title \_\_\_\_\_ Room \_\_\_\_\_  
1:30 p.m. - 2:20 p.m. \_\_\_\_\_  
2:20 p.m. - 3:10 p.m. \_\_\_\_\_  
3:10 p.m. - 3:40 p.m. \_\_\_\_\_  
3:40 p.m. - 4:30 p.m. \_\_\_\_\_  
4:45 p.m. - 6:15 p.m. Workshop:  
Number \_\_\_\_\_ Title \_\_\_\_\_ Location \_\_\_\_\_  
8:00 p.m. - 9:00 p.m. Evening Presentation

### FRIDAY, AUGUST 11

8:00 a.m. - 10:00 a.m. Workshop:  
Number \_\_\_\_\_ Title \_\_\_\_\_ Location \_\_\_\_\_  
10:15 a.m. - 12:15 p.m. Workshop:  
Number \_\_\_\_\_ Title \_\_\_\_\_ Location \_\_\_\_\_  
1:30 p.m. - 4:30 p.m. General Session  
4:45 - 6:15 p.m. Workshop:  
Number \_\_\_\_\_ Title \_\_\_\_\_ Location \_\_\_\_\_  
8:00 p.m. - 9:00 p.m. Evening Presentation

### SATURDAY, AUGUST 12

8:00 a.m. - 10:00 a.m. Workshop:  
Number \_\_\_\_\_ Title \_\_\_\_\_ Location \_\_\_\_\_  
10:15 a.m. - 12:15 p.m. Workshop:  
Number \_\_\_\_\_ Title \_\_\_\_\_ Location \_\_\_\_\_  
1:30 p.m. - 5:20 p.m. General Session  
6:45 p.m. - 10:00 p.m. Reception, Banquet, Special Presentation

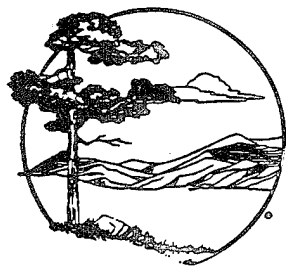


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**Wednesday, August 9, 1995**

**RESEARCH  
ABSTRACTS**

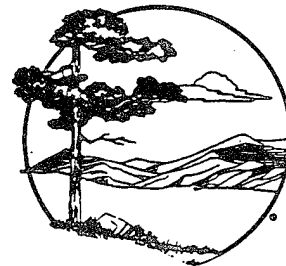
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## WILDERNESS MEDICAL SOCIETY

### ABSTRACT FORM

Second World Congress on Wilderness Medicine  
August 6-10, 1995  
The Ritz-Carlton, Aspen, Colorado



Name of presenter: Wyatt W. Decker, MD

Name(s) of author(s): Wyatt W. Decker, MD, Richard C. Dart, MD, PhD, Ray A. Garcia, BS

TITLE: Heat and Motion Stability of Polyvalent Crotalidae Antivenin, Ovine Fab

Body of Abstract: The abstract must be typed double-spaced in no less than 10-point type size and no more than 12 characters per inch. It must be limited to the space of this page. Do not include references, illustrations, or funding sources. Tables, when appropriate, are acceptable.

**Background.** Prehospital use of Antivenin (Crotalidae) Polyvalent [Wyeth] (Wyeth AV) is both dangerous (due to anaphylaxis) and impractical (because of the numbers of vials needed and the need for skin testing). These factors make its use impossible under field conditions. Clinical trials of a new antivenin, Polyvalent Crotalidae Antivenin, Ovine Fab (FabAV) are underway in the United States. FabAV is produced in sheep immunized with four venoms: eastern diamondback (C. adamanteus), western diamondback (Crotalus atrox), Mojave rattlesnake (C. s. scutulatus), and cottonmouth (Agkistrodon piscivorus). Preliminary research on Fab based antivenoms has demonstrated a high efficacy and minimal adverse reactions. As a first step in evaluating field application of FabAV, this study was conducted to assess the hypothesis that FabAV in commercially packaged unopened vials is stable and will remain efficacious for up to 60 days at a temperature of 70°C. **Methods.** Groups of 5 CD-1 mice were administered serial concentrations of C. atrox venom to establish a modified LD<sub>50</sub> for the venom. Groups of 3 FabAV vials were then subjected to temperatures of 4°C (control), 50°C, and 70°C for periods of 15, 30, and 60 days at each temperature. To study the effects of vibration, 3 vials underwent 30 hours in a rock tumbler prior to spending 60 days at 70°. The FabAV vials were then reconstituted and administered in serial concentrations to groups of mice pre-venomated with 2.25 times the LD<sub>50</sub> of C. atrox venom. **Results.** The C. atrox venom modified LD<sub>50</sub> was 18.9 mg/kg. Results on the efficacy of the various antivenin vial groups are pending. **Conclusions.** The LD<sub>50</sub> for C. atrox found was similar to but slightly higher than previous reports. Comments on the heat and motion stability of FabAV are reserved until the completion of this study.

## **Oxygen Saturation During Sleep at High Altitude and the Effect of the Benzodiazepine Hypnotic Temazepam.**

DUBOWITZ, G.

BRITISH MOUNT EVEREST MEDICAL EXPEDITION 1994

Poor sleep is commonly reported at high altitude. This study was conducted on 12 Volunteers at 5300m on Mt. Everest to observe changes in arterial oxygen saturation during sleep and observe the effect of the benzodiazepine hypnotic temazepam. Arterial oxygen saturation was measured continuously during the night using pulse oximetry, and a subjective appraisal of the quality of sleep was also made. Subjects were randomised to have temazepam 10mg (a benzodiazepine hypnotic) or placebo on 2 consecutive nights (alternating on the second night). Results were analysed with respect to mean oxygen saturation, and the amount of oscillation of saturation overnight. The results were also analysed to show the duration of action of temazepam by comparing the effect during the first and last two hours of sleep.

All subjects noted improvement in quality of sleep with temazepam compared to placebo. A marked oscillation in saturation was also noted in all subjects during sleep. These oscillations were reduced in subjects using temazepam. This reduction lasted throughout sleep, but was more marked in the earlier stages.

While improving the quality of sleep, temazepam did not produce a significant change in mean saturation, when compared to placebo. However, it did produce a significant reduction in the amount of oscillation in saturation during sleep. The exact mechanism for this response is unclear, but it is most probably related to a central effect with reduction in excitability of receptors.



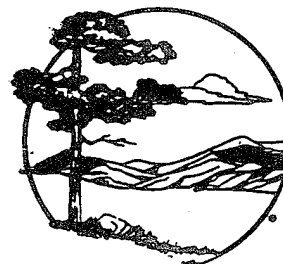
# WILDERNESS MEDICAL SOCIETY

## ABSTRACT FORM

Second World Congress on Wilderness Medicine

August 6-10, 1995

The Ritz-Carlton, Aspen, Colorado



Name of presenter: G. Fasching

Name(s) of author(s): G. Fasching, R. Pretscher

TITLE: Helicopter evacuation in alpine areas using a cable winch -  
experience of an Austrian helicopter rescue service

Body of Abstract: The abstract must be typed double-spaced in no less than 10-point type size and no more than 12 characters per inch. It must be limited to the space of this page. Do not include references, illustrations, or funding sources. Tables, when appropriate, are acceptable.

Emergencies in alpine regions are often critical due to delayed alarm, exposure of the patient and often due to difficult terrain. Prehospital treatment is essential in trauma patients. In Austria doctors of an emergency rescue system come to the patient to start immediate treatment and stabilisation before transport. Thus mortality and morbidity can be lowered significantly.

We report the experience of the Austrian helicopter rescue base „Christoph“ which is located in an alpine area with mountains from 1500 up to 3000 m of height. To offer special prehospital treatment for patients in the mountains in time the use of helicopter rescue services seems mandatory. Very often a helicopter landing is impossible and a cable winch manoeuver has to be performed. The helicopter Alouette III is equipped with a cable winch and a 25 m cable. The doctor will be roped down from the hovering helicopter to the patient. After medical treatment the injured person is placed in a rescue bag and he and the doctor are salvaged by means of the cable winch, wound up to the helicopter and brought to a landing place where definite prehospital therapy will be continued.

In a 2-year period 119 alpine helicopter rescue actions using a cable winch were performed. In 44 cases the persons were rescued from rock walls or ridges. The rescued persons were mainly hikers, climbers, skiers and paragliding pilots. In total 137 persons were evacuated: 110 suffered from trauma, 4 from cardiovascular problems, the remaining 23 were uninjured fellows.

24% of all actions were aggravated by bad weather, inaccurate information or darkness. The average flight time to the place of emergency was 24 minutes. Severity of injury was on average NACA 3, 23 (17%) patients were severely injured.

Helicopter transport to the nearest appropriate hospital is the best and most beneficial of all transport facilities for the patient.

For perfect handling and treatment the doctor should be qualified in emergency medicine and should also have experience in alpine medicine and techniques.

**WILDERNESS MEDICAL SOCIETY****ABSTRACT FORM**

**Second World Congress on Wilderness Medicine**  
**August 6-10, 1995**  
**The Ritz-Carlton, Aspen, Colorado**



Name of presenter: Markus Forsythe, MD

Name(s) of author(s): Schmidt, TA, Federiuk, CS, Zechnich, AD, Forsythe, M, Andrews, A, Christie, M

TITLE: ALS in the Wilderness: Five Year Experience of the Reach and Treat Team

Body of Abstract: The abstract must be typed double-spaced in no less than 10-point type size and no more than 12 characters per inch. It must be limited to the space of this page. Do not include references, illustrations, or funding sources. Tables, when appropriate, are acceptable.

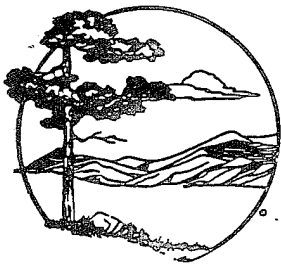
**Introduction:** Increased recreational use of the wilderness raises questions about the value of providing ALS care in the backcountry. Since 1989 the Reach and Treat (RAT) Team has provided ALS care in the wilderness area surrounding Mt Hood, Oregon.

**Purpose:** To describe patient demographics, terrain, injuries and ALS treatment of patients in the wilderness environment.

**Study design:** Retrospective, observational analysis of RAT missions from 1989-1994 based on data sheets maintained by the RAT team, prehospital run sheets and hospital charts.

**Results:** Of the 114 missions analyzed, the median time of missions was 3 hr, 9 min (range 44 min to 76 hr), and 22% required technical climbing skills. Of the 74 patients treated, 55 (90%) received ALS care: 8 were intubated, 52 required IVs, and 24 received morphine for pain. 32 patients were entered into the local trauma system. The most common injuries were extremity injuries (58), head injuries (18), and hypothermia (15). No injuries to RAT team members occurred during these missions, although two minor injuries occurred while training and testing.

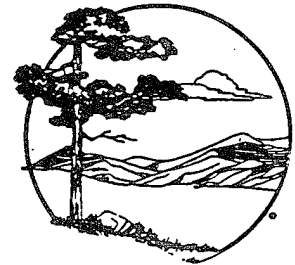
**Conclusions:** Wilderness trained paramedics can safely provide ALS care in a backcountry environment. This care may improve patient comfort during long extrication and speeds the arrival of potentially life saving interventions such as advanced airway management.



WILDERNESS MEDICAL SOCIETY

ABSTRACT FORM

Second World Congress on Wilderness Medicine  
August 6-10, 1995  
The Ritz-Carlton, Aspen, Colorado



Name of presenter: Colin K. Grissom, M.D.

Name(s) of author(s): Colin K. Grissom, M.D., Guy A. Zimmerman, M.D., Ralph E. Whatley, M.D.

TITLE: P-selectin, E-selectin, and Von Willebrand Factor in Acute Mountain Sickness and High Altitude Pulmonary Edema

Body of Abstract: The abstract must be typed double-spaced in no less than 10-point type size and no more than 12 characters per inch. It must be limited to the space of this page. Do not include references, illustrations, or funding sources. Tables, when appropriate, are acceptable.

P-SELECTIN, E-SELECTIN, AND VON WILLEBRAND FACTOR IN ACUTE MOUNTAIN SICKNESS AND HIGH ALTITUDE PULMONARY EDEMA

Grissom, C.K., G.A Zimmerman, and R.E. Whatley.

Pulmonary Division, University of Utah, Salt Lake City, UT, 84132  
and the Denali Medical Research Project, Alaska.

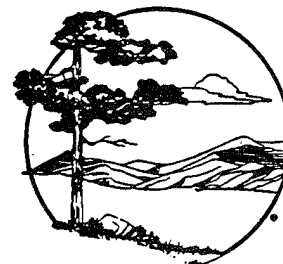
Impaired pulmonary gas exchange occurs in acute mountain sickness (AMS), and non-cardiogenic pulmonary edema occurs in high altitude pulmonary edema (HAPE). To determine if pulmonary endothelial cell activation or injury occurs after acute ascent to high altitude, in AMS, or in HAPE, we measured plasma concentrations of E-selectin, P-selectin, and von Willebrand factor (VWF). Selectins are glycoproteins expressed on injured or activated endothelial cells that mediate tethering of leukocytes to injured endothelium and, along with VWF, are secreted into plasma. We measured plasma concentrations of E-Selectin, P-Selectin, and VWF in seven control subjects at sea level and after ascent to 4200 m on Mt. McKinley, Alaska. We also measured levels of these markers in five climbers with AMS and four climbers with HAPE who presented to a medical camp at 4200 m on Mt. McKinley. E-Selectin significantly increased from  $5.7 \pm 3.5$  ng/ml at sea level to  $15.6 \pm 9.3$  ng/ml after ascent to altitude. In the control group, P-selectin and VWF after ascent to altitude were not significantly different than sea level values. In climbers ill with AMS and HAPE levels of selectins E and P were not significantly different than the control group at high altitude. Levels of VWF were increased in climbers with HAPE (156% of control values), but not in climbers with AMS, as compared to controls at altitude. We conclude that an increase in E-selectin after ascent to altitude arises from endothelial cell activation, but no further increase was seen with AMS or HAPE. This contrasts with ARDS where E-selectin and P-selectin plasma concentrations are markedly elevated. The changes in E-Selectin with ascent to altitude and increased VWF in HAPE suggest that vascular injury plays a role in high altitude illness.



# WILDERNESS MEDICAL SOCIETY

## ABSTRACT FORM

Second World Congress on Wilderness Medicine  
August 6-10, 1995  
The Ritz-Carlton, Aspen, Colorado



Name of presenter: Robert S. Hamilton, MSIV

Name(s) of author(s): Robert S. Hamilton MSIV, Terry Olson RN, Peter T. Pons MD FACEP

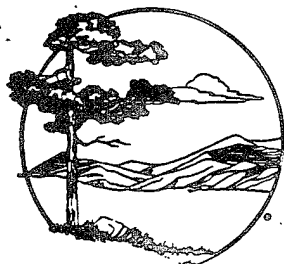
TITLE: The Use of Full-Body Vacuum Splints for Mountain Rescue

Body of Abstract: The abstract must be typed double-spaced in no less than 10-point type size and no more than 12 characters per inch. It must be limited to the space of this page. Do not include references, illustrations, or funding sources. Tables, when appropriate, are acceptable.

**Introduction.**— For years, the accepted standard of spinal immobilization after traumatic mechanism of injury has been the rigid backboard. Recently, a number of manufacturers have introduced full-body vacuum splints which are purported to have several advantages over the backboard. A recent study has shown them to provide cervical spine immobilization comparable to the backboard and cervical collar, and this finding may help to propel them into even wider use. Vacuum splints are well suited for some special purpose uses and these will be discussed, particularly with regard to mountain rescue.

**Setting.**— The Rocky Mountain Rescue Group, based in Boulder, Colorado, is one of the busiest mountain rescue groups in the United States, with 159 calls for assistance and 99 field missions recorded in 1994. The group has been using full-body vacuum splints for all patient evacuations (in excess of 300) for approximately 5 years and has accumulated significant experience with these devices.

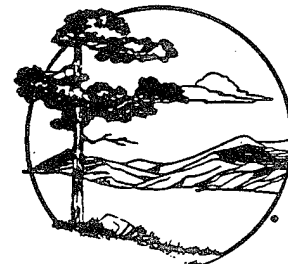
**Discussion.**— The current generation of vacuum splints is very durable and has been used without significant problems in the very demanding environment of mountain rescue. Their flexible nature and relatively light weight allows them to be conveniently carried into the field on the backs of rescuers. For the purpose of mountain rescue, where evacuations are often many hours and over very rough terrain, the vacuum splint is far more comfortable for the patient than a backboard, and may help to reduce unnecessary emergency department radiography secondary to discomfort associated with the backboard. Because of the way the patient is surrounded by the vacuum splint, patients actually have better total spinal immobilization than is possible with a backboard. Furthermore, the versatility of the vacuum splint and its ability to be molded to the patient's individual anatomy is a significant advantage when dealing with some extremity and spinal injuries. The full-body vacuum splint has been found to be a superior alternative to the backboard under the conditions commonly encountered in mountain rescue operations. The vacuum splint's qualities of greatly increased comfort, better immobilization, and versatility are desirable for other prehospital settings as well..



# WILDERNESS MEDICAL SOCIETY

## ABSTRACT FORM

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Name of presenter: Dominique JEAN

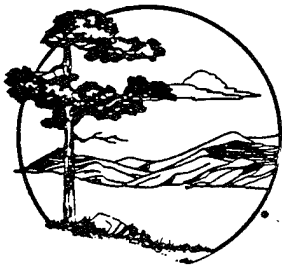
Name(s) of author(s): Dominique JEAN, Jean-Pierre HERRY, Jean-Paul RICHALET, S.KIRKESSELLI

TITLE: EVALUATION OF A CALCIUM BLOCKER (ISRADIPINE) IN ACUTE MOUNTAIN SICKNESS PROPHYLAXIS.

Body of Abstract: The abstract must be typed double-spaced in no less than 10-point type size and no more than 12 characters per inch. It must be limited to the space of this page. Do not include references, illustrations, or funding sources. Tables, when appropriate, are acceptable.

A calcium blocker (nifedipine) has been shown effective for prevention and treatment of high altitude pulmonary edema (HAPE) (Oelz 1989, Bärtsch 1991). Three recent studies did not find an effect in prevention of acute mountain sickness (AMS) but concerned small numbers of subjects (Bradwell 1993, Hohenhaus 1994, Dugas 1995). We studied 103 subjects during an ascent of Mont Blanc. They were randomly assigned to receive in a double-blind manner either isradipine (ICAZ LP 5mg, Sandoz Lab., group I, n=51) or placebo (group P, n=52). The drug was taken orally the night before ascent, the morning of ascent and at the arrival at Vallot Observatory where the subjects spent the night, and the next morning before climbing the summit. At different times, AMS was quantified using the Lake Louise consensus score (self assessment score and clinical score) and physiological parameters were measured: heart rate (HR), blood pressure (BP) and transcutaneous O<sub>2</sub> saturation (SaO<sub>2</sub>). There was no significant difference in the mean clinical and self assessment scores nor in HR, BP and SaO<sub>2</sub> between the 2 groups. However severe cases of AMS were more frequent in the P group (7 cases vs 3 cases). 38 subjects reached the summit (21 in group I, 17 in group P, n.s.). The treatment was well tolerated, except for one case of hypotension. In conclusion, calcium blockers are not recommended for prevention of AMS and their use should be limited to prevention and treatment of HAPE.

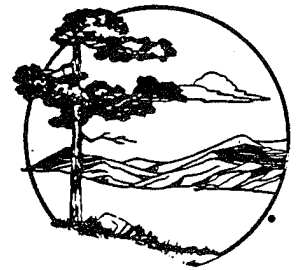




## WILDERNESS MEDICAL SOCIETY

### ABSTRACT FORM

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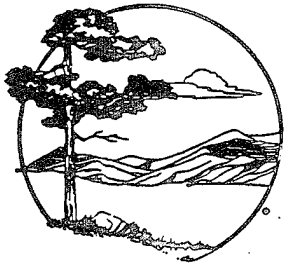
Name of presenter: Peter J. Koltai, M.D., F.A.C.S., F.A.A.P.

Name(s) of author(s): Peter J. Koltai, M.D., Joseph R. Steiniger, M.D., Dimitry Goufman, M.D.  
Steven M. Parnes, M.D.

TITLE: Head and Neck Trauma Associated with Downhill Skiing

Body of Abstract: The abstract must be typed double-spaced in no less than 10-point type size and no more than 12 characters per inch. It must be limited to the space of this page. Do not include references, illustrations, or funding sources. Tables, when appropriate, are acceptable.

The purpose of this study was to establish a better understanding of ski related head and neck injuries, with the hope that such knowledge would be helpful in developing strategies for reducing their incidence and severity. As the only Level 1 trauma center in Northeastern NY which provides services for the Adirondack Mountains, the Catskill Mountains, and the ski areas of southern Vermont, and western Massachusetts, we are uniquely situated for the collection of such information. Our data was retrospectively derived on an ongoing basis for hospital admission records starting with the 1982/83 ski season [December 1- April 1] through the 1993/94 ski season. During this period 48 patients were admitted with 90 ski related head and neck injuries. Thirty-seven had concussions/contusion type closed head injuries, 20 had facial and scalp lacerations, 14 had skull fractures, 13 had maxillofacial fractures, 5 had temporal bone fractures, and 1 had a cervical spine fracture. There was one post admission mortality. Of the 13 patients with maxillofacial fractures, 1 had a pan facial fracture, 3 had LeFort type maxillary fractures, 3 had trimalar fractures, 3 had orbital fractures, 2 had mandibular fractures, and 1 had a dentoalveolar fracture. The cause of injury was striking a tree in 18 [37.5%], hitting the ski slope in 15 [31%], unknown in 10 [21%], colliding with another skier in 3 [6%], crashing into trailside rocks in 1 [2%], and colliding with a lift pole in 1 [2%]. Of the 48 patients, 24 [50%] were expert skiers, 14 [29%] were intermediate skiers, 7 [15%] were beginners. We did not obtain the ability level of 3 [6%] of the patients. The ages of our patients ranged from 7-52 years with a median of 22 years, and a mean of 23.2 years. Thirty-six [75%] were male and 12 [25%] were female. Our data shows the young male expert skier as being at significantly greatest risk for head and neck injuries, especially when he skis near the side of the slope, loses control and collides with a tree. In conclusion, skiing is inherently a risky sport and while refinements in trail design and better hazard instruction may result in small reductions of major head and neck injuries, we believe that a better approach would be the use of safety helmets.



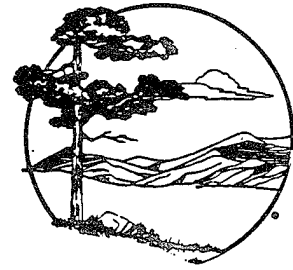
## WILDERNESS MEDICAL SOCIETY

### ABSTRACT FORM

Second World Congress on Wilderness Medicine

August 6-10, 1995

The Ritz-Carlton, Aspen, Colorado



Name of presenter: Ponchia Andrea, MD

Name(s) of author(s): Ponchia A. MD, Noventa D. MD, Sarto P. MD, Zaccaria M. MD

**TITLE: OXYGEN CONSUMPTION AND ENERGY EXPENDITURE DURING HIKING AT HIGH ALTITUDE**

Body of Abstract: The abstract must be typed double-spaced in no less than 10-point type size and no more than 12 characters per inch. It must be limited to the space of this page. Do not include references, illustrations, or funding sources. Tables, when appropriate, are acceptable.

The aim of our study was to assess oxygen consumption ( $VO_2$ ) and energy expenditure (EE) during hiking at high altitude, directly in a field setting.

Prior to a Himalayan climbing expedition (Shakaur Peak, 7100m; Pakistan Karakorum), eight healthy male subjects (aged 33.4 yrs, range 28-37) completed a maximum graded exercise test (modified Bruce protocol) to determine maximal oxygen uptake ( $VO_{2max}$ ) ( $65.3 \pm 4.6 \text{ mL}\cdot\text{Kg}^{-1}\cdot\text{min}^{-1}$ ), heart rate ( $HR_{max}$ ) ( $193.5 \pm 11.2 \text{ b}\cdot\text{min}^{-1}$ ) and pulmonary ventilation ( $V_{emax}$ ) ( $160.4 \pm 14.9 \text{ L}\cdot\text{min}^{-1}$ ), using a breath-by-breath system (MGC 2001 System). A portable telemetry system (Cosmed K2), whose validity and reliability were previously established in our laboratory in comparison with the breath-by-breath system (ANOVA with repeated measures and Bland-Altman method,  $\alpha = 0.05$ ), allowed to measure  $VO_2$ , HR and  $V_e$  during a brief steep off trail ascent from the base camp (4400 m), carrying a 8-Kg backpack. The measurements were obtained on the first (P1) and the third (P2) week after arrival at high altitude.

The individually selected rates of climbing were  $439 \pm 120 \text{ m}\cdot\text{hr}^{-1}$  in P1 and  $444 \pm 91 \text{ m}\cdot\text{hr}^{-1}$  in P2, with a mean oxygen consumption during steady state of  $20.8 \pm 2.5 \text{ mL}\cdot\text{Kg}^{-1}\cdot\text{min}^{-1}$  in P1 and  $19.5 \pm 3.6 \text{ mL}\cdot\text{Kg}^{-1}\cdot\text{min}^{-1}$  in P2, corresponding to  $31.7 \pm 4.9 \%$  and  $29.8 \pm 5.4 \%$  of sea level  $VO_{2max}$ , respectively. The differences were not significant. During a brief bout of maximal speed at the end of the ascent, the peak oxygen uptake was  $26.7 \pm 1.6 \text{ mL}\cdot\text{Kg}^{-1}\cdot\text{min}^{-1}$  in P1 and  $28.1 \pm 4.6 \text{ mL}\cdot\text{Kg}^{-1}\cdot\text{min}^{-1}$  in P2, corresponding to  $40.6 \pm 3.9 \%$  and  $43.0 \pm 5.6 \%$  of sea level  $VO_{2max}$ , respectively. The slight increase in P2 was not significant. The mean net energy expenditure rate, calculated assuming the respiratory exchange ratio equal to 1, was  $5.16 \pm 0.62 \text{ kcal}\cdot\text{min}^{-1}$  in P1 and  $5.39 \pm 0.88 \text{ kcal}\cdot\text{min}^{-1}$  in P2, respectively. The corresponding work output (in power units) was  $5.25 \pm 1.6 \text{ kJ}\cdot\text{min}^{-1}$  in P1 and  $5.38 \pm 1.36 \text{ kJ}\cdot\text{min}^{-1}$  in P2, with a mechanical efficiency of  $24.1 \pm 5.6 \%$  and  $23.9 \pm 4.2 \%$ , respectively. In P2 mean heart rate during steady state decreased significantly compared to P1 value ( $119.9 \pm 7.6 \text{ b}\cdot\text{min}^{-1}$  vs  $131.6 \pm 15.7 \text{ b}\cdot\text{min}^{-1}$ ;  $P < 0.05$ ); even peak heart rate slightly decreased in P2, but not significantly. A significant rise in hemoglobin concentration was observed in P2 compared to P1 value ( $17.9 \pm 1.4 \text{ g}\cdot\text{dL}^{-1}$  vs  $15.0 \pm 1.2 \text{ g}\cdot\text{dL}^{-1}$ ;  $P < 0.05$ ).

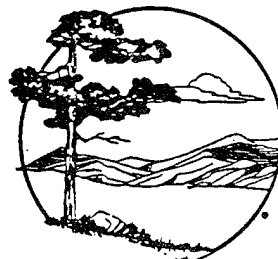
In conclusion, during hiking at high altitude the mountaineers appear to choose a moderate level of exercise intensity, allowing them to climb over 400 meters per hour off trail. Mean and peak exercise metabolic power does not change after a two-week acclimatization, but mean heart rate decreases in relation to the increased oxygen carrying capacity of blood.



# WILDERNESS MEDICAL SOCIETY

## ABSTRACT FORM

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Name of presenter: ZIA-UR-RAHMAN

Name(s) of author(s): ZIA-UR-RAHMAN

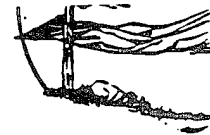
TITLE: EFFECT OF SOME HERBAL PLANTS ON BLOOD CHEMISTRY IN RABBIT

Body of Abstract: The abstract must be typed double-spaced in no less than 10-point type size and no more than 12 characters per inch. It must be limited to the space of this page. Do not include references, illustrations, or funding sources. Tables, when appropriate, are acceptable.

In developing countries medicinal plants are widely used by traditional practioners in their dar to dat practice in human and animals. The present study was conducted to see the effect of *Grewia asiatica*, *Gymnema sylvestre* and *Gossypium herbacium* on the blood biochemicals parameters of normal and diabatic rabbits at various time intervals. Normal and alloxan treated rabbits were fed 20 ml of each drug prepared in corboxymethyl cellulose solution in water on body weight basis.Reduction in blood glucose was significant at 4,8 and 12 hours after treatment with *G. asiatica* in diabetic rabbits. Likewise, a significant reduction in the cholesterol and triglyceride levels was observed in normal and diabatic rabbit. *G. herbacium* did not produced any effect in normal but a decrease glucose concentration was observed at 4 and 8 hour in diabatic rabbits. *G. sylvestre* had a significantly low glucose at 8 hour in diabatic rabbits. Cholesterol and triglycerides levels were low but again to non significant level.



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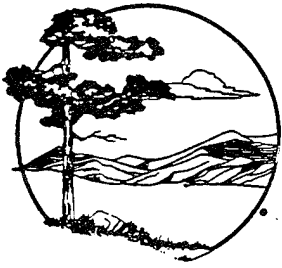


Name of presenter: William A. Robinson MD

Name(s) of author(s): P. Matthew Grandstaff MD, Robert L. Muelleman MD, William A. Robinson  
Effects of Polyethylene Glycol Conjugated Superoxide Dismutase on  
TITLE: Frostbite Injury in New Zealand White Rabbits

Body of Abstract: The abstract must be typed double-spaced in no less than 10-point type size and no more than 12 characters per inch. It must be limited to the space of this page. Do not include references, illustrations, or funding sources. Tables, if appropriate, are acceptable.

Free oxygen radicals have been postulated to be an important mediator of injury in frostbite. A long-acting version of the endogenous scavenger enzyme, superoxide dismutase, has been created by conjugating it with polyethylene glycol (pegorgotein, formerly known as PEG-SOD). The current study evaluated the efficacy of pegorgotein on frostbite tissue survival when administered prior to rewarming. In a prospective study, two groups of 9 rabbits received a standardized frostbite injury using a modified Weatherley-White model. A control group received no pharmacologic therapy; the treatment group received 10,000 IU/kg of pegorgotein intravenously immediately post injury. Healing was followed until a clear line of demarcation was apparent (10 days). The percentage of viable ear surface remaining at the end of the study was measured and used to compare the effectiveness of treatment. Student's T test was used to determine statistical significance. The study was designed to have an 80% ability to detect a 35% difference in tissue survival. No significant difference in frostbite injury ( $p=0.967$ ) was observed between the control and treatment groups. The treatment group showed a  $9.3\% \pm 15.5\%$  tissue survival while the control group had a  $9.6\% \pm 14.5\%$  tissue survival. These results indicate no significant treatment effect for pegorgotein on tissue survival in a rabbit frostbite injury model when administered immediately post injury.



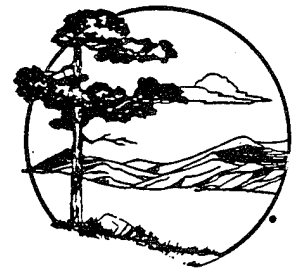
# WILDERNESS MEDICAL SOCIETY

## ABSTRACT FORM

Second World Congress on Wilderness Medicine

August 6-10, 1995

The Ritz-Carlton, Aspen, Colorado



Name of presenter: William H. Shoff, M.D.

Name(s) of author(s): William H. Shoff, M.D. and Suzanne Shepherd, M.D.

TITLE: Poor Compliance with Preventive Measures for Malaria and Traveler's Diarrhea in Developing Countries: A Preliminary Report

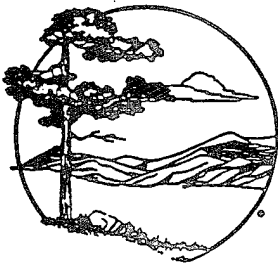
Body of Abstract: The abstract must be typed double-spaced in no less than 10-point type size and no more than 12 characters per inch. It must be limited to the space of this page. Do not include references, illustrations, or funding sources. Tables, when appropriate, are acceptable.

Objectives: To determine the compliance of travelers to developing countries with personal protective measures (those known to decrease risk for food, mosquito, and water borne illness) and with chemoprophylaxis for malaria. To determine the extent that travel insurance was purchased.

Methods: Telephone survey after the trip.. During a pre-trip visit(s) clients were extensively counseled verbally (excluding travel insurance), given handouts, and allowed to ask questions.

Setting: University travel medicine service. Participants: First-time clients of the service.

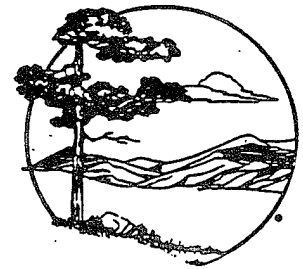
Results: Preliminary results with 50 conducted surveys indicate a mean compliance of 61% with each of 14 items (precautions) surveyed. Eight travelers followed all of the food and water precautions (9 items); none developed diarrhea. Of the travelers, who failed to follow one or more of the precautions, only fourteen developed diarrhea. Precautions were not followed, e.g., because "I had an antibiotic anyhow." Most travelers did not follow all of the mosquito precautions (6 items). None have developed malaria to date. Three travelers did not complete the prescription, e.g., because of forgetting. Most of the travelers did not purchase travel insurance. Unproved, folklore, remedies, e.g., vitamin B6, were used for malaria prophylaxis on three occasions. Travelers noted discrepancies between accepted travel information selected places and the reality they found. The clientele of the survey were highly-educated and welcomed all the information provided. They want more information about adventurous travel. Conclusions: The compliance was less than expected given the education level of the participants and the extensive pre-trip counseling. The demand for travel medicine knowledge and skills expands daily requiring more research to fine-tune pre-trip counseling and clarify what preventive measures really work and why.



# WILDERNESS MEDICAL SOCIETY

## ABSTRACT FORM

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Name of presenter: IGOR B. TEKAVČIČ. M.D.

Name(s) of author(s): IGOR B. TEKAVČIČ. M.D.

TITLE: CLINICAL ASSESSMENT OF INTRACRANIAL INJURY AND FIRST AID IN THE WILDERNESS

Body of Abstract: The abstract must be typed double-spaced in no less than 10-point type size and no more than 12 characters per inch. It must be limited to the space of this page. Do not include references, illustrations, or funding sources. Tables, when appropriate, are acceptable.

Sometimes it is very difficult to assess properly the extent of brain injury in first hours after severe systemic injuries, even in the hospital with all facilities. It is much harder to do so in the field.

While an apparently highly destructive injury, if it spares vital areas and is properly treated, may be survived with minimal aftereffects. A seemingly minor trauma with only transient loss of consciousness, if neglected, may not infrequently lead to permanent mental and physical deficit and even death.

So how can we decide in the mountains whether the urgent helicopter transport to the hospital is vital? We can categorise closed head injuries in three groups:

1. Low risk for intracranial injury :

Findings : asymptomatic, headache, dizziness, scalp hematoma, laceration, contusion or abrasion.

Recommendation: observation by reliable person (head injury sheet).

2. Moderate risk for intracranial injury:

Findings: history of change of consciousness on or after injury, progressive headache, ethyl alcohol or drug intoxication, posttraumatic seizure, unreliable or inadequate history, age less than 2 years, vomiting, posttraumatic amnesia, signs of basilar skull fracture, multiple trauma, serious facial injury, possible depressed fracture.

Recommendations: send for admission, close observation, CT.

3. High risk for intracranial injury :

Findings : depressed level of consciousness not clearly due to alcohol intoxication, drugs, postictal; focal neurological findings, decreasing level of consciousness, penetrating skull injury or depressed fracture.

Recommendations: helicopter transport to the hospital with neurosurgical facilities, CT, emergency burr holes (?).

Most of the patients in high risk group need intubation.

Indications for the intubation in head trauma are :

- so depressed level of consciousness that patient can not protect his airway.
- Glasgow coma scale less than 7 (need for hyperventilation).
- severe maxillofacial trauma.
- need for pharmacologic paralysis for management.

We must always bear in mind that we can prevent secondary brain injury by continuous and sufficient supply of oxygen and glucose. We must try to prevent the respiratory acidosis, try to maintain isotonicity of blood, salt and water balance. Also some other aspects of pathophysiology of head injuries in the wilderness will be discussed in detail.



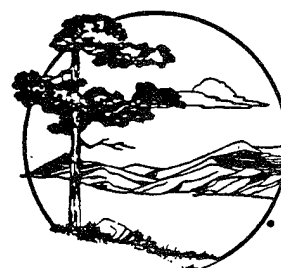
## WILDERNESS MEDICAL SOCIETY

### ABSTRACT FORM

Second World Congress on Wilderness Medicine

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The Ritz-Carlton, Aspen, Colorado



Name of presenter: Jonathan L. Temte, M.D., Ph.D.

Name(s) of author(s): Jonathan L. Temte, M.D., Ph.D.

TITLE: Relationship between Hematocrit and Serum Cholesterol at High Altitude

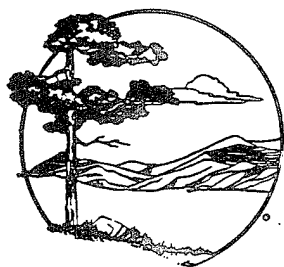
Body of Abstract: The abstract must be typed double-spaced in no less than 10-point type size and no more than 12 characters per inch. It must be limited to the space of this page. Do not include references, illustrations, or funding sources. Tables, when appropriate, are acceptable.

Specific guidelines exist for screening of serum cholesterol level to assess cardiovascular disease risk. In contrast, little attention has been directed to hematocrit screening. These two laboratory values, however, have been shown to be significantly correlated. This positive correlation may be due simply to dilution effect. For example, a high hematocrit produces a smaller volume of dilution for cholesterol, thus resulting in higher serum concentration. Consequently, acclimatization to high altitude may affect serum cholesterol level.

Blood samples were collected opportunistically from each of 433 patients (0-93 years; 63% female) at a family practice clinic in Madison, Wisconsin (altitude = 264m). Serum cholesterol level and hematocrit were normally distributed with mean values of 191.2 mg/dl and 41.1%, respectively. Based on these findings, a explanatory model was proposed:  $\text{Serum Cholesterol (mg/dl)} = \text{Constant} * 100 / (100 - \text{hematocrit})$ , where the constant was predicted as the product of the mean serum cholesterol and mean relative serum volume. Data were fitted to this model after adjustment for age and sex using multiple linear regression techniques.

The model derived from patient values was not significantly different from that developed from the theoretical relationship between hematocrit and serum cholesterol. Furthermore, it explained 18.6% of the variation in cholesterol level ( $r^2=0.186$ ;  $F[3,429]=32.72$ ;  $P<0.001$ ). Therefore, a dilution model appears to appropriately describe the relationship between serum cholesterol and hematocrit.

The cholesterol dilution model was then tested using a population acclimatized to high altitude. Similar data were collected from chart reviews at a family practice clinic at Leadville, Colorado (altitude = 3105m). The model derived from this high-altitude population was compared to that derived from the low-altitude population using analysis of covariance. The results of this comparison will be discussed as will the implications for cardiovascular risk for populations living at, or moving to high altitudes.



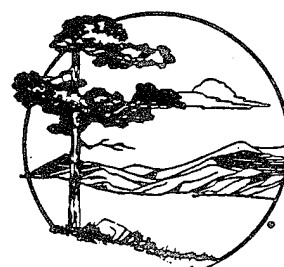
# WILDERNESS MEDICAL SOCIETY

## ABSTRACT FORM

Second World Congress on Wilderness Medicine

August 6-10, 1995

The Ritz-Carlton, Aspen, Colorado



Name of presenter: STEPHEN H. THOMAS, MD

Name(s) of author(s): S H THOMAS, C KEITH STONE MD

TITLE: USE OF MECHANICAL COMPRESSIONS TO IMPROVE CPR QUALITY IN GROUND AND AIR AMBULANCES

Body of Abstract: The abstract must be typed double-spaced in no less than 10-point type size and no more than 12 characters per inch. It must be limited to the space of this page. Do not include references, illustrations, or funding sources. Tables, when appropriate, are acceptable.

**Background** Growing popularity of wilderness activities will present EMS systems with an increasing number of critically ill/injured patients requiring long distance evacuation. However, recent research has clearly demonstrated an inability of EMS crews to provide adequate chest compressions in moving ambulances or helicopters. This inability to provide adequate CPR is likely to preclude optimal outcome in otherwise salvageable patients in the wilderness medical population, which is generally young and healthy and may have other characteristics (e.g., hypothermia) contributing to increased survivability from cardiorespiratory arrest. The objective of this study was to evaluate the ability of ground and air EMS crews to provide adequate CPR with use of a mechanical chest compressor.

**Methods** This study used methods identical to previous EMS CPR investigations except for use of mechanical chest compressions (Thumper, Michigan Instruments, Grand Rapids MI). Five minutes of compressions were performed in three settings: ED (Control), ambulance (Ground), BO-105 helicopter (Air). Compressions (placement and depth) were assessed using an electronic mannequin (ResusciAnnie, Laerdal, Armonk NY).

**Results** Mean attempted and correct compressions/minute in the Air and Ground settings were compared with Control using Dunnett's test; no differences from control were found in either Ground or Air groups.

<u>Compressions per minute</u>	<u>Control</u>	<u>Ground</u>	<u>Air</u>
attempted	80.2 $\pm$ 0.45	80.0 $\pm$ 0.71	79.6 $\pm$ 0.55
correct	80.2 $\pm$ 0.45	79.4 $\pm$ 0.89	79.2 $\pm$ 0.84

**Conclusion** Using the same methodology which previously identified poor chest compression quality in EMS settings, this study demonstrated effectiveness of a mechanical chest compressor. Provision of adequate CPR during long transports may contribute to increased survival in patients evacuated from wilderness settings.





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## Stress hormones response to different stimuli at sea level and during high altitude hypoxia.

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High altitude (HA) has been reported to stimulate stress hormones secretion. Exhaustive exercise and insulin-induced hypoglycemia are also two powerful stressors, but their effects on stress hormones at high altitude are not completely known.

The aim of the study was to evaluate the hormonal response to these stressors both in normoxia conditions and during acute and chronic HA hypoxia exposure.

Six trained male subjects participated three years apart in the same protocol consisting in four stages: at sea level, during the first week at 5,050 m (Pyramid Laboratory, Lobuche, Nepal), after 25 days at the same altitude, and within 10 days after returning to sea level.

In the first study the stressor was a cycle ergometer exhaustive graded exercise (50 W x 3 min); in the second the stressor was an insulin test (0.1 U/kg b.w.). Plasma samples were assayed by RIA for ACTH, hGH, hPRL,  $\beta$ -endorphin, cortisol. Basal values were analyzed by Student's paired t-test; responses to stressors were compared by ANOVA for repeated measures and by Bonferroni's method as post hoc test.

HA induced no significant effects in most of basal plasma hormone concentrations. Only resting plasma cortisol concentrations were increased in both studies in the first week of HA hypoxia (in the first study from  $9.68 \pm 1.49$  (SE) to  $13.48 \pm 1.82$  ug/dl,  $P < 0.05$ , in the second study from  $4.77 \pm 0.58$  to  $6.10 \pm 0.71$  ug/dl,  $P < 0.05$ ). At HA hormonal responses to maximal exercise and insulin test were similar to those at sea level, except for a blunted hPRL response to exercise both in the acute and in the chronic HA hypoxia.

In conclusion, acute and chronic HA hypoxia did not impair stress hormones response to exhaustive maximal exercise and to insulin-induced hypoglycemia confirming at HA the permanence of an efficient hormonal response to stressors.

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**Wednesday, August 9, 1995**

**WARNINGS IN  
THE WILDERNESS**

*Ken Zafren, MD*

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## WARNINGS IN THE WILDERNESS

Ken Zafren, MD  
Anchorage, Alaska USA

"No traffic cop whistled them off the hidden rock in the next rapids." - Aldo Leopold

### OBJECTIVES

Following this presentation, participants will be able to:

1. identify issues involved in posting warning signs in wilderness and semi-wild areas.
2. recognize some wilderness hazards even if not marked by warning signs.

"The tendency nowadays to wander in wildernesses is delightful to see," wrote John Muir (in 1901). The same could be said about our time, almost a century later. Now, however, many managers of public lands would like, if not to post a traffic cop by the hidden rock in the next rapids, at least to post a sign warning river runners. For now, most of the warnings remain at the trailheads, but increasingly, the vision of wilderness as a place where "the hand of man has never set foot" is sullied by warning signs.

What is the natural limit of these warnings? Clearly, one cannot post a sign over every cliff or crevasse. The United States National Park Service was successfully sued by a foreign tourist whose wife was crushed by a rock that fell from the snout of the Exit Glacier in Kenai Fjords National Park, Alaska. Now there is a warning sign that cautions people not to walk right up to the snout where large rocks sit on an icy surface above; these rocks should look menacing enough to an observer. The difference between this spot and a dozen similar ones in the same park is that the Exit Glacier is the only one with a road almost to its base. Could the Park Service be sued by someone who happened to reach one of the other sites on the theory that if Exit Glacier is hazardous enough to post, other sites should also have warning signs? What about signs warning of recent bear activity in a given area which are used in the Chugach State Park near Anchorage. If I disturb a bear feeding on a carcass in an area that doesn't have such a sign and am mauled, should I sue the State of Alaska because they had a duty to warn me? Finally, what of signs that warn that a trail is closed but are not accompanied by a fence or a guard. Do such signs absolve a manager of potential liability or increase it.

Some of the "warnings" are reasonable. A rickety bridge in Nepal has a sign warning not to cross more than two people or one porter at a time. This is wilderness only in the sense that there are no roads or medical facilities nearby. A nesting area for raptors is off limits and the boundary posted along adjacent trails in Colorado. In most cases, however, I vote with Aldo Leopold, that we should have the freedom to make mistakes.

When I first began to visit wilderness areas in the lower 48 states, it was common to wonder where the trailhead was. Often there would be a car or two pulled off in a lot and no obvious sign. Now more signs mark the trails and others warn that marmots will eat the insulation off the wiring in your vehicle. I will continue to look for the blank spot on the map, preferably one with very few signs on the ground.

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Wednesday, August 9, 1995

**MEDICO LEGAL  
ISSUES: DUTY  
TO WARN**

*Carolyn Langer, MD, JD, MPH*

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DUTY TO WARN AND USE DUE CARE-  
INJURY TO THE RESCUER AND RESCUER RIGHT TO RECOVER

Presented by Carolyn S. Langer, M.D., J.D., M.P.H.  
Boston, Massachusetts

ML Strategies, Inc.- Senior Professional Consultant

Harvard School of Public Health- Instructor in Occupational  
Medicine and Lecturer in Occupational Health Law

BACKGROUND:

During previous sessions of the WMS, we reviewed key medico-legal concepts in the practice of wilderness medicine. We analyzed liability issues surrounding medical malpractice and medical clearance of participants in wilderness pursuits. We also discussed Good Samaritan laws and circumstances in which rescuers may have an affirmative duty to act.

In this session we will analyze a concept that is rarely considered by rescue workers; namely, their own right to recover for injuries they sustain while attempting to assist others. The golden rule sounds simple: look out first and foremost for your own safety (i.e., the safety of the rescuer). However, the expanding involvement of participants in wilderness pursuits is likely to increase the probability that you yourself as a healthcare provider will sustain injuries while rendering first aid or emergency services in these remote settings. The goal of this lecture is to provide medico-legal risk management principles for confronting these rescue situations and to equip healthcare providers with information concerning their own legal rights.

OBJECTIVES: Following this presentation, participants will be able to:

1. Identify the duty owed to rescuers by victims, communities, landowners, trip organizers, and other third parties.
2. Recognize the necessary elements to bring a cause of action against parties responsible for a rescuer's injuries.
3. Understand the "Fireman's Rule" and its inapplicability to most voluntary first aid workers.
4. Identify risk management principles in rendering wilderness medicine services, including those factors that may justify termination of a rescue attempt.

## **How Wilderness Medicine Differs (Goth, 1991)**

- 1. Extended Patient Management**
- 2. Extreme Environments**
- 3. Limited Equipment**

# **The Rescue Doctrine**

**As a general rule, a person injured in the course of undertaking a necessary rescue may, absent rash or reckless conduct on his part, recover from the person whose negligence created the peril which necessitated the rescue.**

# **CASE STUDY**

## **Injury to the Rescuer**

**TW Corp. owned certain Bakersfield property along the Panorama Bluffs.**

**On 6/5/88 MC was teaching his daughter how to start a campfire on these lands when the fire grew out of control and engulfed them.**

**JL, a passerby who received burn injuries while rescuing them, now sues the landowner, alleging, inter alia, negligent creation of a highly dangerous fire hazard by failure to comply with local weed abatement ordinances.**



# Negligence

- Duty
- Breach of Duty
- Causation
  - Cause-in-fact
  - Proximate cause
- Damages

# **Good Samaritan Protection**

**No liability shall be imputed to:**

- 1. A licensed physician and surgeon or any other person, who in**
- 2. good faith**
- 3. renders emergency care or assistance**
- 4. at the scene of an emergency or accident**
- 5. without compensation**
- 6. except for gross negligence or by willful or wanton acts or omissions.**

# **Simple vs. Gross Negligence**

## **Simple Negligence**

**Failure to adhere to a standard of care followed by a reasonably prudent person under similar circumstances**

## **Gross Negligence**

**Extreme or outrageous departure from the standard of care beyond that followed by even an unreasonable or imprudent person**

# No Duty To Rescue

The law generally imposes no liability upon those who stand idly by and fail to rescue a stranger who is in danger.

There is no duty to rescue endangered strangers.

## Termination of Rescue Services

The rescuer may normally abandon efforts at any time unless, by giving the aid, the rescuer has put the victim in a worse position than before the rescuer's attempt to aid.

The motives in discontinuing the services are immaterial. The rescuer may without liability discontinue the services through mere caprice, or because of personal dislike or enmity toward the victim.

# Liability for Termination of Rescue Attempt

The rescuer is liable when his/her assistance has put the victim in a worse position than before either because:

- the rescuer's partial performance has increased the actual danger of harm to the victim, or
- the victim has been induced to forego other opportunities to obtain assistance in reliance upon the rescuer's undertaking.

Then, the rescuer is not free to discontinue services where a reasonable person would not do so.

# Abandonment

The unilateral severance of the physician-patient relationship by the physician without reasonable notice to the patient, when continued medical attention is still necessary.

- Pre-existing Duty: a valid physician-patient relationship
- Does not exist if a physician permissively refuses to enter into such a relationship with a particular person

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**Wednesday, August 9, 1995**

**WILD ANIMAL  
ATTACKS**

***Lily Conrad, MD, PhD, FACEP***



## Wild Animal Attacks

Lily Conrad, PhD, MD, FACEP  
Emergency Medicine  
Denver, Colorado

Objectives: Following this presentation, participants will be able to:

- Describe the epidemiology, mechanisms and field care of wild animal attacks
- Discuss antibiotic choice and wound care for wild animal attack victims
- Understand the varieties of wild animal attack occurring in the USA as well as abroad and discuss attacks by different types of wild animals

There are few wild large animals remaining in the United States: bears, bison, cougars (mountain lions) and alligators. Despite this, attacks on humans still occur. Wild animal attacks outside the USA are a more common occurrence.

The medical literature on wild animal attacks is very limited, and frequently anecdotal. Attacks, especially fatalities, are more often reported- and sensationalized- in the media.

The incidence of wild animal attack injuries is not known. Reporting is not mandatory, and many attacks are not recorded. Perhaps one or two deaths occur annually in the USA.

Outside the USA, animal attacks by crocodiles, elephants, cape buffalo, lions, or tigers are a much greater cause of morbidity and mortality. Deaths from wild animal attacks worldwide have been estimated. Man-eating crocodiles kill over 1,000 people per year in Africa. Tigers kill 600 to 800 people in India; lions kill 300 to 500 in Africa, elephants 200 to 500 in Central Africa and India; hippopotamus 200 to 300. Fatalities from African buffalo, rhinoceros, hyena, Eurasian wolves, Indian sloth bear, camel and ostrich attacks are also reported.

Wild animal attacks occur most often in rural or wilderness settings, a long distance from hospital care. Prevention, field treatment and scene safety therefore assume considerable importance. In an increasing number of parks and wilderness areas, warnings signs are posted.

Prevention of wild animal attacks is largely common sense and awareness. Travel in groups. Be aware of and knowledgeable about the animal habitat through which you travel. Take precautions in camping and food handling.

Generally if an encounter with a large wild animal occurs, try to remove yourself from the scene quietly and slowly. Running or fleeing will elicit a predatory response. In most cases, if attacked: fight back. Vigorous resistance with physical fighting, including striking the attacking animal with fists or any object or weapon, has been effective in repelling attacks by cougars, lions, tigers, brown and black bears, and even crocodiles.

### CARE OF ATTACK VICTIMS

All victims of animals bites should be evaluated for blunt trauma and internal injuries that may be less obvious than the bite wound itself. Victims of large wild animal attacks sustain major trauma. Bites and attacks by large wild animals can cause extensive tissue damage or loss, open fractures and extensive blunt trauma. Injuries are commonly worse than suspected initially. Suspect occult injuries

Wild animal attacks are not always bites. Mechanisms of injury also include goring by horns, lacerations from claws, cutting and crushing as well as blunt trauma from the victim's being tossed in the air, butted, or trampled. Search for blunt trauma and more injury than seems evident in victims of large wild animal attack or bite. Was the victim thrown in the air? Butted? Dragged under water? Thrashed or thrown about? Clawed? Trampled?

Blunt trauma mandates evaluation for cervical spine injury, closed head injury, intraperitoneal bleeding and internal chest trauma. Multiple rib fractures with pneumothoraces, pelvic and skull fractures, renal contusion evidenced by hematuria, subdural hematoma and splenic rupture have all been reported with wild animal attacks. Extremity fractures are also likely.

Liberal use of X-ray and other imaging modalities such as CT scanning in evaluation of bites and wounds from large wild animals is recommended.

Beware! Anticipate neurovascular damage. Remember: bites, gorings or claw wounds are likely deeper and more severe than initially apparent. Neurovascular damage is common. Anticipate multiple trauma. Secure the ABC's first. Follow ATLS protocols. Treat the wild animal attack victim as a multiple trauma patient.

At the wilderness scene of a wild animal attack, assess the victim for injuries and the scene for safety. Is the animal gone, or liable to return to attack again? Tracking or capture of the attacking animal may be undertaken by those with expertise, but only after care to the victim is assured.

Treatment of animal attack wounds can be initiated in the field. ABCs are first as always. Airway management may be complicated by facial, neck or chest injuries. Bleeding is controlled by direct pressure. Wash and irrigate the wounds, using the cleanest water available. Filter or boil water if this can be quickly accomplished. Cover open wounds with clean cloths or sterile bandages, if available. Remove debris or foreign bodies as possible. Splint large open wounds and lacerations as well as suspected fractures.

Evacuation and transport are priorities. The highest level of prehospital medical care available should be provided. Victims of large wild animal attack, even with stable vital signs, will usually need emergent evacuation from the field for definitive medical care. Air transport may be appropriate.

Definitive treatment for animal attack wounds, generally in a hospital setting, includes exploration of the wounds with determination of the extent of the injury, irrigation and cleaning, removal of any foreign bodies and contaminants, and debridement of devitalized tissue. Antibiotic therapy and tetanus and rabies prophylaxis should be considered.

Puncture wounds are a special problem. Immediately inoculated with oral flora from teeth in bite wounds and contaminated with soil bacteria in goring injuries, they are very difficult to irrigate or clean adequately. Do not suture puncture wounds. Search for retained foreign bodies and debris.

Hands are frequently injured in an attempt at defense against the animal attack. Complex anatomy makes definition of the extent of hand wounds, as well as cleaning, more difficult. Relatively poor vascularization makes infection more likely.

Irrigation of the wound is essential. This is the most important step in wound care for preventing infection. Irrigate with 500cc or more of sterile normal saline, or 5% providone-iodine solution under mild pressure. A large syringe with a 19 gauge needle is suggested, or a commercial set may be used.

Sharp careful debridement may be needed to remove the crushed, torn, devitalized or necrotic tissue commonly found in the jagged, dirty, deep tissue injuries characteristic of large wild animal attacks

If wounds are so large or extensive that closure is necessary, operative surgical intervention is often indicated. Bite wounds to the hands should be left open if at all possible. Plastic surgical consultation may be appropriate, especially for facial and hand wounds. Hospitalization will be indicated for wound exploration, operative repair, parenteral antibiotics and/or observation of many wild animal attack victims.

Rehabilitation needs, psychiatric trauma and post-traumatic stress syndrome, in rescuers as well as victims, should not be overlooked.

#### ANTIBIOTICS AND INFECTIONS

Large wild animal bites and attack wounds are high risk for infection. These injuries are considered contaminated. The Centers for Disease Control recommends rabies prophylaxis for all large wild carnivore bites.

The real rabies danger from wild animals is unknown; it is probably low for bears, but a rabid cougar attack occurred in California in 1994. Animals considered high risk for rabies transmission are skunks, raccoons, and bats. Rabbits, rodents, urban dogs and cats are low risk.

Rabies prophylaxis and immunization are given as quickly as possible after a high-risk bite wound. After 48 hours, effectiveness decreases. Human rabies immune globulin (HRIG) provides passive immunity until active immunity develops from the simultaneously administered human diploid cell vaccine (HDCV).

The CDC previously required confirmation of antibody titers in all persons receiving the HDC vaccine, but these were so routinely high the requirement was discontinued.

HRIG = Human Rabies Immune Globulin

Dosage: 20 I.U./kg

Infiltrate 1/2 the dose, ie., 10 IU/kg locally around the bite wound if feasible; and then give intra-muscular injection of 1/2 the dose, i.e. 10 IU/kg in deltoid or thigh. Injection into adipose tissue may (disasterously) decrease effect in rabies prevention.

HDCV = Human Diploid Cell Vaccine

HDCV is initially given simultaneously with HRIG, though at a separate site.

Dosage is 1.0 ml intramuscular (IM) on days 0, 3, 7, 14 and 28.

Prophylactic immunization against rabies is recommended for long-term travellers to parts of Africa, the Far East, India, or other remote areas where rabies is endemic. HDCV is used for pre-exposure prophylaxis. Dosage is 0.1 ml intradermally on days 0, 7 and 28.

Standard tetanus prophylaxis is recommended. If no previous tetanus immunization, initiate primary series and give tetanus immune globulin 250 units IM. If previously immunized, update with dT (diphtheria-tetanus) booster as indicated. If in a wilderness or remote area, remember you have 72 hours in which tetanus booster administration will be effective. However, update of immunization before departing for remote or extended travel seems the wiser course.

Prophylactic antibiotics are probably the standard of care now for bites and injuries from large wild animal attacks, although academically their efficacy in infection prevention has not been confirmed.

Wound infections and bacterial contaminants differ by animal species. Bites from cougars and all large cats, are high risk for *Pasturella multocida* infection. *Pasturella multocida* is a small, nonmobile organism which grows in both aerobic and anaerobic

conditions. Alligator and crocodile injuries are often contaminated with *Aeromonas hydrophilia*, a fresh water pathogen. Studies of bear oral flora document presence of *Micrococcus* and *Streptococcus* species. Soil bacteria may contaminate gorings by bison or other horned animals.

Frequent pathogens in bite wounds include not only *Pasturella multocida*, but also aerobic bacteria such as *Staphylococcus aureus*, *Streptococcus*, *Eikenella corrodens*, *Hemophilus aphrophilus* and enterobacter species; anaerobes include *Bacteroides* species, *Peptococcus* and *Fusobacterium* species. *Streptococcus*, *S. aureus*, *P. multocida*, *E. corrodens* and gram - negatives are the most major concerns.

Cephalosporins are a frequent choice for general use in prophylaxis. They are effective against strep and staph bacteria, and adequate for *P. multocida*.

Commonly used regimens include:

Cefazolin (Ancef)

1.0 gram IV q 6 hours

Cephalexin (Keflex)

500 mg PO qid

Ceftriaxone (Rocephin)

500 mg to 1.0 gram IV q 12 to 24 hours.

Adds gram-negative coverage; not so good for

*Staphylococcus*

Penicillin is a drug of choice for cat bites of all types as it is a most effective antibiotic for *Pasturella multocida* infection.

Aqueous Penicillin G, 2 to 4 million units q 4 to 6 hours IV

Penicillin VK 500 mg. PO qid

More broad-spectrum penicillin derivatives such as amoxicillin clavulanate (Augmentin) or dicloxacillin are frequent choices for out-patient bite wound management.

Augmentin : 250 to 500 mg PO tid

Ampicillin-sulbactam (Unasyn) 3 grams IV is useful for cellulitis or systemic sepsis. Alternatives in antibiotic therapy for bite wounds includes ciprofloxacin (Cipro) 500 mg bid. Tissue penetration to infected bite sites may not be as effective with use of erythromycin or tetracycline, and treatment failures have been reported with these. Gentamicin, ciprofloxacin, ceftriaxone and trimethoprim-sulfamethoxazole are effective antibiotics for alligator bites.

Empiric wound cultures are not indicated. If there is wound infection or sepsis both wound and blood cultures may be helpful.

Complications from bite wounds include local wound infection, cellulitis and lymphangitis, as well as systemic sepsis and bacteremia. Bacteremia can seed infection to distant sites, with resulting osteomyelitis, meningitis, septic arthritis or pneumonia. Immunocompromised patients (diabetics, HIV +, chronic alcoholics) are at higher risk for sepsis and complications

#### ANIMAL- SPECIFIC CONSIDERATIONS

Bear, wolf

Isolated attacks on humans by wolves and coyotes have been reported. Wolves are being reintroduced to wilderness areas. Packs of wolves are only historical or potential threats to humans in the USA currently.

Bears attack and injure an estimated 20 to 100 people annually in the USA, including Alaska. Fatal bear attacks are reported almost every year. The incidence of bear attacks with injuries in the US is not known with any precision. Black, brown, grizzly and polar bears have all been implicated in provoked and unprovoked attacks. Grizzly are often the most publicized, and the most lethal.

Well-publicized attacks have occurred in Glacier and Yellowstone National Parks. In July 1967, grizzlies killed two female campers, in separate incidents, in Glacier National Park, a night now known as "The Night of the Grizzly". This incident was at least partially responsible for perpetrating the myth that grizzlies are attracted to attack women during their menses. More recent scientific work has shown no correlation between menstruation and risk of bear attack.

Types of injuries in a bear attack include biting, chewing, clawing, tearing, and batting. Injuries range from minimal scratches to fatal evisceration and amputation. Bears will often attack the victim's face. Extensive tissue loss and neurovascular injury are common. Major associated blunt trauma may be found in the bear mauling victim. Victims may be thrown or tossed many feet into the air, batted with a heavy blunt paw, or fall (or be pulled) from a tree climbed for protection.

Bear attacks are considered in two categories: provoked and unprovoked. Provoked attacks occur when the human is perceived as a threat to the bear, for example, inadvertently coming between a sow and her cubs. Unprovoked attacks are rare, and decreasing as bears' association of humans with food lessens. Cases of predatory behavior, with sleeping campers dragged from their tents and eaten, are however well-known. Different strategies to minimize injury are advised depending on the attack circumstance.

If you are a perceived threat to the bear- for example, a sudden encounter of a feeding bear while hiking- remove the threat. Back away slowly and quietly. Alternatively, in a grizzly attack, drop to the ground and "play dead", lying still and covering your head.

If you are being treated as prey, or food- for example, being dragged from your tent- bear experts recommend vigorous resistance and fighting back. You have nothing to lose, and may startle or deter the attacking animal. Attack prevention is the best policy. Be aware! when you are travelling through bear territory. Travel in groups, and make noise while on the trail, to warn the animal of your approach and allow avoidance. Keep a clean camp, with no food or cooking in or near tents. Have a plan for what to do if an attack occurs.

#### Bison

Most known bison, or American buffalo, goring injuries have occurred in Yellowstone National Park, where an average of 3 visitors per year are gored. 56 cases of injuries from bison have been documented over the past 15 years in Yellowstone, with 3 fatalities since 1975.

True buffalo are found in Asia and Africa; American buffalo likely received their name as a derivation of the French "Les boeufs" in the 1800's. Bison weigh 1,000 to 2,000 pounds and can sprint or charge at over 20 mph. Horns are sharply pointed, 8 to 10 inches long. A herd of over 4,000 bison is free-ranging within Yellowstone.

There are two mechanisms of injury in a bison attack: penetrating, with punctures from goring by horns and blunt, from being tossed into the air or butted by the bison head. Of the 56 cases of bison attack, 36 were goring injuries, with 14 victims tossed into the air (usually 10 feet or more). 11 victims were butted or shoved by the massive bison head. Similar injuries result from bull-gorings in rodeo, agriculture or bullfighting.

Buttocks and thighs are most often the sites of goring injuries, as the victim will frequently turn to run. Goring to the abdomen, with evisceration has also been reported. Blunt trauma results in fractures of ribs, pelvis, vertebrae or extremities.

The large goring/puncture wounds often require operative treatment for adequate cleaning, debridement and closure. Despite their seemingly dirty nature, or perhaps because of prompt prophylactic antibiotic administration, infection in these wounds is rare.

Prevention of attacks by bison largely is a matter of not approaching too closely (25 feet). Many injuries have occurred during photography of or with the bison.

#### Cougar

Attacks on humans by cougars, or mountain lions, are increasingly frequent, with over 50 attacks documented since 1970. Two of the three adults killed in the western USA since 1991 were jogging on wooded trails. 5 child fatalities are known.

Cougars are now found in many western US states. Their population is making a significant comeback since their change in status to a protected species. They were eliminated from the eastern US around the turn of the century. Attacks have occurred recently in California, British Columbia, Colorado, Montana and Washington.

Cougars are solitary, maintaining an individual range. At about 18 months of age, young cougars must establish their own hunting territory, and may be pushed into less desirable, human-inhabited regions. Young cougars have been responsible for most attacks on humans.

Attacks on groups of people are not uncommon. A rabid cougar attacked a group of 3 adults in California in 1994; a group of 5 small children was attacked in 1991.

Because of their smaller size, high-pitched voices and quick movements in play, children are at higher risk for cougar attack than adults. Attacks on children have had medicolegal consequences, including prohibition of children in some California parks.

Cougar attacks are aimed at the victim's head and neck. They will bite through the great vessels and airway, or snap the neck forcibly back to fracture the victim's cervical spine. Puncture wounds from teeth are often much deeper than suspected. CT scanning or other imaging may be needed to determine the extent of injury.

Adults attacked by cougars with any chance to defend themselves have most often been mauled, especially on face and hands, but not killed. If you encounter a cougar, or are attacked, wildlife experts recommend attempting to look as large and threatening as possible, making loud noise, and vigorously fighting and resisting attack. Do not stoop down, make direct eye contact, or run.

#### Alligator

Alligator bites and attacks are among the most prevalent large wild animal injuries in the USA. In Florida from 1973 to 1990, 127 attacks are documented, 5 of them fatal. Alligators are found in the wild as well as more urban settings in the Southeastern states of the USA including Florida, Alabama, Louisiana and Georgia. Crocodiles are very similar reptiles found in Africa, Asia and Australia, where they cause considerable morbidity and mortality.

The exact numbers of people injured or killed by alligators is impossible to know as many attacks occur which are not recorded or reported. In some cases, it has been difficult to determine if the victim drowned, then was taken to be eaten, or if the alligator attack was the primary cause of death.

Alligator attacks on swimmers often involve massive bite trauma to the torso, with penetrating chest or abdominal injuries. The massive jaws exert tremendous force in closing, causing a crushing bite. Open fractures result from bites to extremities.

Alligators will grab the victim then roll underneath the water, resulting in drowning, or thrash the victim side to side. Injuries from a strike by the massive tail may also occur. If attacked, vigorous resistance is advised: some victims have been released to escape.

Even small alligator bites become easily infected. *Aeromonas hydrophilia* is a common pathogen, found in alligator's mouths and in fresh water lakes and streams. A fulminant, bullous cellulitis can result from *Aeromonas hydrophilia* wound infection. Use of ceftriaxone (Rocephin), gentamicin, trimethoprim-sulfamethoxazole or ciprofloxacin is suggested.

Prevention of alligator attacks includes the following. Don't try to touch or feed any alligator or swim with a dog or pet, or swim at dusk, which is feeding time for alligators. Do swim with a partner, avoid water areas with heavy vegetation or poor visibility and swim during daylight

#### Overseas animal attack

Wild animal attacks are a much more significant causes of morbidity and mortality in countries other than the USA. In Africa and Asia (India, Indonesia) elephants, crocodiles, lions, tigers rhinos, hippos and even camels cause thousands of injuries per year.

Occasional man-eating lions and tigers from Africa and India are still reported: several hundred people per year are killed by these large wild cats. As with cougars, attacks typically occur from behind, with bites to the head and neck. With their large size and tremendous strength, a single paw swipe can cause fatal skull or cervical fractures. In Africa, many victims who survive lion maulings die later from infection.

Hyenas in Africa are legendary for decapitating or biting off the face of a sleeping human. These cats are allegedly generally shy, and if there is an opportunity, aggressive defense may deter an attack.

Elephants have a reputation as killers of hunters, though "rogue" attacks on villagers in Africa and India are quite frequently reported. At least 200 deaths per year are caused by elephant attacks. Elephants trample their victim, gore with tusks, or toss the victim into trees or over their back with the powerful trunk. Ripping the victims body and scattering the pieces has been described. Use of elephants as work animals and human settlement within elephant territory, with dwindling elephant food supply, have increased the incidence of elephant attacks.

Black rhinoceros in Africa are known to charge at almost any moving object, with even minimal stimulus (such as the click of a camera). They hook with their horns and toss the victim into the air, as well as trampling anything in their path. Trampling behavior similar to rhinoceros is described for the hippopotamus. Hippos also have large canine teeth and will attack and bite boats or humans in the water, easily chopping them in half.

Attacks by crocodiles are very similar to those described for alligators, but far more common. In Africa, Nile crocodiles kill over 1,000 people per year. Attacks and fatalities are also reported annually in Australia as well as from other parts of Asia such as Papua New Guinea.

Occasional reports of injuries and deaths from attacks by other large wild animals such as camel, kangaroo, African buffalo and wildebeest, wild pigs, moose and elk can be found. Camels have canine teeth and so can bite, severing limbs, or whip their head up and back, fracturing the victims neck.

Across the globe we have more animals, more people, and less territory. As confrontations between man and wild animals result from our progressive encroachment on animal habitat, a tolerant coexistence will hopefully evolve.

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Wednesday, August 9, 1995

**ENVIRONMENTAL  
REFUGEES**

*Aaron Sachs*

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## ENVIRONMENTAL REFUGEES

AARON SACHS  
RESEARCH ASSOCIATE, WORLDWATCH INSTITUTE  
WASHINGTON, DC

### OBJECTIVES:

Following this presentation, participants will....

1. Understand that people become refugees for a variety of reasons other than war, outright persecution, and "ethnic" tensions.
2. Recognize the significance of environmental degradation in causing people to flee in search of better land and more viable livelihoods.
3. Recognize that much environmental degradation occurs in the first place because affected communities are marginalized and lack basic rights and political power.

Many issues commonly seen as "social ills" actually have a large environmental component. Similarly, many issues commonly labelled as strictly environmental problems--the domain of slightly wacky, misanthropic tree-huggers--actually have serious human consequences. The plight of environmental refugees perfectly illustrates this overlap between social and environmental frames of reference.

Millions of people are uprooted every year because they can no longer live healthy, productive lives in their homelands. Water pollution and scarcity, soil erosion, deforestation, desertification, and toxic emissions all contribute to increasing refugee flows. And much of this environmental degradation happened simply because the people it was going to affect were powerless to stop it. When people are forced to leave their homes--for whatever reason--they not only become more vulnerable to the stresses of society, but also add to societal stresses as they look elsewhere for shelter and livelihoods. We could make societies much more stable and secure by easing the pressures that force people to leave home--in other words, by improving ecological conditions and development practices, and by helping communities protect their environments by providing them with information and guaranteed civil rights.

I've attached an article I wrote last year on child prostitution as a case study documenting these general points. Though society has traditionally viewed child prostitution as simply a shameful reminder of the criminal element lurking beneath the surface of our civilization, it is actually rooted in mainstream societal structures. Most child prostitutes, in fact, are environmental refugees.

FURTHER READING ON ENVIRONMENTAL REFUGEES:

Jodi Jacobson, Environmental Refugees: A Yardstick of Habitability, Worldwatch Paper 86 (Washington, DC: Worldwatch Institute, November 1988).

Hal Kane, The Hour of Departure: Forces that Create Refugees and Migrants, Worldwatch Paper 125 (Washington, DC: Worldwatch Institute, June 1995).

The Population Institute, "Desperate Departures: The Flight of Environmental Refugees," a special report of the Population Institute for the U.N. expert Group Meeting on Population Distribution and Migration, 18-22 January, 1993, in Santa Cruz, Bolivia (NY: Population Institute, 1992)

United Nations Development Programme (UNDP), Human Development Report 1994 (NY: Oxford U. Press, 1994).

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Wednesday, August 9, 1995

# ISSUES OF RESCUE

*Steve Pehrson, MD*



# N A S A R

## AND THE NEW WILDERNESS MEDICINE PROGRAM

STEVE E. PEHRSON MD  
DIRECTOR,  
NASAR WILDERNESS MEDICINE PROGRAM

### OBJECTIVES

***BY PARTICIPATING IN THIS PRESENTATION, THE INDIVIDUAL SHOULD:***

- 1. GAIN AN UNDERSTANDING OF NASAR, IT'S PURPOSE, ORGANIZATION, PRESENT EDUCATIONAL OFFERINGS, AND GOALS.***
- 2. BECOME FAMILIAR WITH NASAR'S WILDERNESS MEDICINE PROGRAM.***
- 3. GAIN A NEW INSIGHT INTO THE CHALLENGES FACED BY RURAL AND WILDERNESS E M S PROVIDERS WHO HAVE THE MISSION OF PROVIDING PROLONGED PREHOSPITAL CARE.***
- 4. GAIN A NEW INSIGHT INTO THE NEED FOR INVOLVEMENT BY PHYSICIANS IN THE DEVELOPMENT OF PROLONGED PREHOSPITAL CARE E M S SYSTEMS AT ALL LEVELS.***

### **THE NATIONAL ASSOCIATION FOR SEARCH AND RESCUE ( NASAR )**

NASAR is a non-profit organization dedicated to the education of emergency responders. The organization had it's beginning in 1972. It's motto is "emergency response through education - that others might live". NASAR offers a variety of educational courses spanning a broad spectrum of emergency response applications.

NASAR also has developed the National standards for search and rescue scope of performance, and offers a Nationally recognized certification for search and rescue personnel. NASAR has developed close ties with FEMA and is intimately involved with the development of the urban rescue teams such as those involved with the Oklahoma bombing disaster. Close ties have also

been established with the Mountain Rescue Association. MRA and NASAR present the yearly Technical Rescue Symposium.

The following non-medical courses are presently offered by NASAR.

- Introduction to Search and Rescue ( ISAR ), 20 hours.
- Fundamentals of Search and Rescue ( FUNSAR ), 45 hours.
- Introduction to the Incident Command System, home study.
- Incident Commander: Search and Rescue (IC:SAR ), 24 hours.
- Incident Commander: Emergency Response (IC:ER ), 24 hours.
- Planning Section Chief: Search and Rescue (PSC:SAR ), 24 hours.
- Managing The Lost Person Incident (MLPI ), 24 hours.
- Basic Water Rescue Preparedness (BWRP ), 16 hours.

The following scope of performance certifications are offered by NASAR.

- Search and Rescue Technician - level III. ( SAR-TECH III )
- Search and Rescue Technician - level II. ( SAR-TECH II )

Search and Rescue Technician - Level I ( SAR-TECH I ), is in the final stages of development and is expected to be available early in 1996.

### **NASAR'S WILDERNESS MEDICINE PROGRAM**

The Wilderness Medicine Program was completely redesigned in the spring of 1995, and for the first time brought "in house" as opposed to being a contracted program. The traditional offerings of Wilderness First Aid ( 24-hours ), Wilderness First Responder ( 80-hours ), and Wilderness EMT ( 60-hours ) remain, but with some changes in curriculum and design. Additionally, some new offerings are in the developmental stages. An advanced course, the Wilderness Medic Course will focus on advanced medical skills applied to the prolonged care situation. And a Wilderness Physician Course which will teach physicians the management skills needed to direct prolonged prehospital care EMS personnel, and provide some direct insight into the wilderness prehospital situation.

#### ***THE PROLONGED CARE MIND-SET***

With a change in program administration, a fresh approach to prolonged prehospital care education evolved. For EMS level people to truly function in the prolonged care environment, a collection of tools is needed to "reset" thinking from a brief prehospital encounter, to one of total patient care over the course of hours to days. This is a concept that is totally foreign to conventional EMS education and application. This is, perhaps, one reason that prolonged care education and protocols have been slow in finding accepted application at State levels.

The medical principles of prolonged care are found under three fundamental concepts. These three concepts must be integrated into the "wilderness medicine" education of EMS personnel if

the application of prolonged patient care in the prehospital setting is to be effective.

### Pathologic Progression

Pathological progression is a fundamental medical concept, but one that is essentially absent from conventional EMT curriculums. This is not surprising, as EMS personnel are trained to provide initial emergency care during a 20 minute patient encounter. In my experience, when that twenty minute interval has passed and the initial interventions are done, panic sets in. If a patient's situation is deteriorating and the EMT has exhausted his/her limited knowledge and initial interventions, there remains nothing left for the EMT to work with. The result is frustration and panic in the mind of the EMT. In urban situations this is an infrequent situation. However in rural areas it is a common occurrence.

In order to function with effectiveness in a prolonged care situation the care giver simply has to know more than what is provided through a conventional EMT course. The patient care responsibilities associated with prolonged care are immensely greater than those associated with a brief patient care situation.

With an understanding of pathological processes comes the ability to anticipate changes in patient condition and allow advanced patient care planning. Patient trends become meaningful and treatments become logical. I am constantly reminding my EMTs that they have to learn to think. In the prolonged care setting, the ability to analyze patient information and use that to make prudent patient care decisions is a critical skill. I have been told that I'm expecting too much from medical personnel trained at a prehospital care level. My experience in educating EMTs in rural Utah has proven to me that these are realistic expectations, providing the EMTs are given the education and tools to work with.

### Environmental Medical Considerations

This has been the focus of traditional wilderness medicine courses. Undoubtedly, the impact of environmental challenges on a patient is potentially of immense consequence in a wilderness situation. Often, the impact of the environment is additive to other injury or illness. In the hospital situation we seldom need to worry about on-going environmental challenges. However, in the wilderness situation, the necessity to protect both the patient and the care giver from persistent environmental challenge can be of primary importance. The wilderness setting provides the scenario for multiple attacks on a patient's homeostasis. The concept of multifactorial patient presentations is fundamental to prolonged prehospital patient care.

### Medical consequence of initial care interventions

The conventional EMS provider seldom sees the consequences of his/her actions. I have seen pressure necrosis in patients confined to a backboard. The medical care rendered was not inappropriate, and was based upon the EMT's knowledge. However, after 4 hours a complication resulted. This could have been anticipated in the mind of any physician or RN, but not in the mind of a conventional EMT. Not only are such eventualities of medical interventions

not taught in conventional EMS education, EMTs seldom see the results of their care. In the prolonged care situation, EMTs will see the results of their interventions, for better or worse. Another example is drug reactions. In 20 minutes, many drugs are just beginning to exert their effects. Allergies and idiosyncratic reactions may not be seen for some time. The conventional EMT will never encounter these situations but those having prolonged care responsibilities someday will.

As it can be surmised from the preceding discussion, educational challenges are abounding in the arena of prolonged care EMS. Wilderness EMS experience is slow to come by. Rural EMTs may see only a few critical cases a year. EMS personnel dedicated to wilderness medical response may see even fewer. Fundamental prolonged care patient issues such as prolonged pain management and longterm fluid resuscitation are advanced skills that lie beyond the scope of a 60-hour basic wilderness EMT course. To date such training has been beyond reach of prehospital care providers. However, these are the type of skills needed if an advanced level of care is to be realized in the prolonged prehospital care context.

## **MEDICAL CONTROL ISSUES**

In today's world, this fact is plain. If the field EMT does not have medical control, first aid is the level of care that can be legally provided. EMS control physicians are often hesitant to develop or adopt prolonged care protocols. There is probably a variety of reasons for the lack of physician acceptance or recognition of the issues confronting the prolonged prehospital care provider. Probably the best way to change the present situation is to provide education to local EMS physicians and State level policy makers. In all reality, things are likely to change little for the prolonged care EMS provider until prolonged prehospital care issues are addressed by the physicians functioning in EMS control positions.

## **NASAR'S POSITION**

Being a non-profit professional organization, NASAR's involvement in wilderness medicine education is not motivated by commercial interest. We perceive a genuine need for this training. We also perceive some significant short comings in what is commercially available. From an EMS perspective, the ability to deliver advanced medical care to remote locales hinges upon the availability of trained providers and upon the endorsement of medical control physicians. The practice guidelines established by the Wilderness Medical Society have already proven invaluable to those of us working to legitimize prolonged prehospital care. It is NASAR's ambition to remain in the forefront of education for the wilderness emergency responder. It is hoped that cooperation and active liaison with other professional organizations such as the Wilderness Medical Society will accelerate the process of developing wilderness EMS standards and training. It was mentioned in the preceeding discussion that the EMS provider tasked with prolonged

prehospital care simply has to know more. They must know more in the way of medicine and associated skills, but they must also know a broad spectrum of non-medical outdoor skills and rescue skills. It is the goal of NASAR to be the vehicle that provides the education needed by those practicing wilderness emergency response.

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Wednesday, August 9, 1995

**DUTY  
TO CARE**

*Carolyn Langer, MD, JD, MPH*

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*Please refer to Medico Legal Issues - Duty to Warn*

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Wednesday, August 9, 1995

**SURVIVING  
THE UNEXPECTED  
NIGHT OUT**

*Ken Zafren, MD*

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## **SURVIVING THE UNEXPECTED NIGHT OUT**

Ken Zafren, MD

Alaska Mountain Rescue Group  
Anchorage, Alaska USA

### **OBJECTIVES**

Following this presentation, participants will be able to:

1. prepare to survive an unexpected night out under unfavorable conditions of weather and terrain.
2. apply the physiological and psychological principles governing survival and use these principles to establish priorities in an emergency.
3. learn to improvise essentials.
4. act more effectively as members or advisors of search and rescue groups.

There should be no such thing as an "unexpected" night out," but there are different degrees of expectation. In climbing, spending a night out without the benefit of a tent or other shelter is called a bivouac. There are planned bivouacs and unplanned bivouacs, the usual difference being a major one in terms of comfort.

Since human beings are tropical animals, the main difficulties of survival come from heat loss. A bivouac in a warm, dry environment causes little problem. One of my first bivouacs occurred when I became lost in Florida. When it got too dark to see where I was going, I simply lay down on a flat spot and slept fitfully while armadillos rustled a nearby palmetto bush. In the morning I found myself.

A common argument runs as follows: if you carry enough gear for a bivouac, you are more likely to require one because the extra weight and bulk will slow you down. Most climbers adopt a compromise position. They carry enough gear to survive a night, albeit uncomfortably. The common causes of unplanned bivouacs are a route which takes longer than expected, loss of visibility either by being benighted or by whiteout conditions, a problem such as an injury, illness or loss of

equipment or simply being lost and unable to find an established camp. Many of these eventualities can be prevented by proper planning.

To survive a night, human beings need protection against hypothermia by some combination of clothing and shelter. Water and food (in that order) are helpful adjuncts, but neither is strictly necessary for a single night if adequate protection from cold is available. In very cold environments however, unavailability of water and food are risk factors for frostbite and hypothermia. Altitude illness is a third consideration if one has climbed high enough during a day and is unable to descend to a more moderate altitude. This will be covered in other presentations.

One of the great myths of modern backpackers and mountaineers is that there are "ten essentials." I once found an old document from the Seattle Mountaineers written in the 1930s which referred to the "seven essentials" but I was unable to find out what they were. Either people were tougher in those days or they lumped three of the ten essentials in with the some of the others. Mountaineering: Freedom of the Hills (5th edition) lists the "Ten Essentials" as:

1. Map
2. Compass
3. Flashlight/headlamp, with spare bulbs and batteries
4. Extra food
5. Extra clothing
6. Sunglasses
7. First-aid supplies
8. Pocket knife
9. Matches in waterproof container
10. Fire starter.

I can safely say that I have traveled in the wilderness in perfect comfort with none of the above on many occasions, but usually I carry a selection.

Depending on the trip, there may be essentials not on the list. In Alaska in the summer, a headlamp is usually unnecessary. On glaciers or in winter, one may need a stove to make water; all the matches and fire starters won't help if there is nothing to burn; a shovel to dig a snow cave would be worth the weight of ten pocket knives. Under some conditions I would suggest that a radio or cellular phone would be the eleventh essential. Other candidates for the eleventh essential are repair kit (some would advocate just a roll of duct tape), climbing rope, GPS (global positioning system) monitor, or ELT (emergency locator transmitter).



Staying warm involves minimizing heat loss. Heat is lost by convection, conduction, radiation and evaporation. Short of finding a heat source such as a hot springs or being able to build a fire, preventing heat loss by these means may require warm clothing with wind layers and shelter. Simple means such as bivouacking on the lee side of a ridge, building snow or rock walls, and huddling together for warmth may add significantly to one's comfort and chances for survival, even if no shelter is available.

Psychological factors also play a major role in survival. A recent news story concerned a man who went off the road into snow in Oregon and was uninjured. He survived for several weeks without food and with little water. Unfortunately, he put all of his faith in God and none in himself. He would still be alive had he walked 18 miles back down the road. Although he was listed as being from Montana, he had moved less than one year before from Southern California and was unfamiliar with snow. The most important psychological factor is probably knowing when to turn back to avoid a bivouac or at least to guarantee that one can choose a favorable site.

So stay warm and expect the unexpected.

Some possibly useful items:

1. Clothing: rain gear, wind gear, light fiberfill or down parka and overpants, face mask, ski goggles, extra warm hat, overmitts, double boots, gaiters, overboots, extra socks can double as extra mittens.
2. Shelter: tarp, bivouac sack, large plastic garbage bag, pack extension
3. Ground insulation: small thermarest or foam pad
4. Health needs: sunscreen, mosquito repellent, bear repellent aerosol, first aid supplies including moleskin or similar, sunglasses
5. Repair kit: utility cord, sewing kit, tools, knife (Leatherman tool or similar is very useful), duct tape, safety pins (some of these items can also have first aid uses)
6. Food/water: water bottles (insulation for cold trips); stove, fuel, pots, bowl, spoon, plastic for solar stills (dark plastic garbage bags for glaciers), matches, firestarter, lighter (consider neck loop), folding saw, rubber tubing
7. Aids to movement over difficult terrain: ice axe, crampons, specialized ice tools and protection, climbing harness, ropes, ascenders, pulleys, skis, climbing skins, snowshoes, snow anchors, rock anchors and protection
8. Winter/snow: avalanche beacon, shovel, snow saw
9. Headlamp or flashlight
10. Navigation: map, compass, GPS, bamboo wands, surveyor's tape
11. Communications: radios, cellular phones, ELT, flares, change for pay phone, signal mirror

Many items can be improvised if forgotten, broken or lost. Others, such as snow shelters and rock walls, can be constructed from available materials. Even sunglasses can be improvised. Other items can be repaired, even if not improvised.

For further reading:

Bowman W. Wilderness survival In Auerbach PS (editor) *Wilderness Medicine: Management of Wilderness and Environmental Emergencies (Third Edition)* Mosby 1995

Graydon D (editor) *Mountaineering: The Freedom of the Hills* The Mountaineers 1992

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**Wednesday, August 9, 1995**

**INTERNATIONAL  
MEDICAL RELIEF:  
IS IT FOR YOU?**

*Ron Ruffing, MD*

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## **INTERNATIONAL MEDICAL WORK: IS IT FOR YOU?**

Ronald P. Ruffing M.D., MPH.  
Assistant Professor of Emergency Medicine and Pediatrics  
Tufts University School of Medicine  
Boston, Massachusetts

## WORKSHOP EXPERT PANEL

Ronald P. Ruffing, M.D., MPH. (Moderator)  
Assistant Professor of Emergency Medicine and Pediatrics  
Tufts University School of Medicine  
Director, Emergency Medical Services for Children  
New England Medical Center  
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William A. Robinson, M. D.  
Professor and Chair  
Department of Emergency Medicine  
University of Missouri - Kansas City School of Medicine  
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Halim Hennes, M. D., MS.  
Associate Professor of Pediatrics  
Medical College of Wisconsin  
Children's Hospital of Wisconsin - Emergency Department Trauma Center  
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Kurt F. Papenfus, M. D.  
Emergency Medicine Staff Physician  
Aspen Valley Hospital  
Estes Park Medical Center  
Telluride Medical Clinic  
Medical Consultant, Mountain Medicine and Safety . Film "Cliffhanger" 1992  
Team Physician. American Quest for Everest Expedition 1991  
USA Team Physician, Mt. Everest Chinese, Soviet, American Climb 1990  
Snowmass, CO.

## **COURSE OBJECTIVES**

Following this presentation, participants will be able to

1. List three important questions to ask when considering international medical work.
2. Describe the four primary practice environments encountered while working overseas.
3. A sponsoring organization should perform certain tasks. List four sponsoring agency functions to consider before committing to work for a particular international relief or developmental agency.
4. What is your single best resource for information about a particular project or sponsoring agency?

## **International Medical Work is it for You?**

### **I. Deciding to Work Overseas - "Where do I begin?"**

#### **A. Why am I considering working in an international environment?**

1. "Save the World"
2. Personal or self enrichment
  - a. Opportunities to travel
  - b. In-depth, cross-cultural experience
  - c. The fulfillment of a life-long ambition or dream
  - d. The desire to "make a change in your life," "do something meaningful" or "get out of the same old routine."
  - e. To undertake or consider changing careers
  - f. To reconnect with one's ethnic or cultural past
  - g. The need for a temporary break from your current practice routine

#### **B. How much time am I willing to commit?**

1. Short-term work. (Weeks to months)
  - a. Volunteer positions. Volunteers will usually be expected to pay their own travel expenses. Housing and food may or may not be provided.
    - (1) Expenses may be tax deductible. It is important to speak with a tax specialist first and keep careful records .
  - b. Short-term positions are widely available for surgical specialists, anaesthesiologist and dentists.
    - (1) Similar to work at home, volunteers are asked to teach and supervise specialty surgical care.
  - c. Long-term developmental programs have less interest in short-term volunteers.
    - (1) Short-term volunteers burden local health care workers. Workers, time and energy is spent caring for an endless stream of "guests."
2. Long-term work. (six months to one year)
  - a. Position lasting six months or more usually financially supported. Travel and living expenses to be paid. Some agencies may pay an additional salary.
  - b. A vacation period is often included for workers who agree to work for six months or a year.
  - c. Knowledge of the local language is extremely helpful.
  - d. Participation in longer-term projects brings new rewards including a greater sense of cultural sensitivity and membership in the global community.

C. Under what environmental conditions am I willing to work?

1. Personal safety issues
  - a. War Zone
  - b. Volatile or unstable political situations
  - c. Strong anti-western or anti-American sentiment
  - d. Medical risks, especially infectious diseases
  - e. Travel risks
2. Personal comfort issues
  - a. The local climate
  - b. Housing and privacy concerns
  - c. Sanitation, water and electricity availability
  - d. Isolation and interpersonal contact issues
  - e. Communications with home
  - f. Food restrictions or special diets
3. The sponsoring agency should address these issues. Demand frankness about the hazards to your personal safety and comfort.

II. What type of work will I be doing while I am overseas?

A. International medical work can be classified into four major categories. Each category operates in a different environment and has different goals.

1. Emergency medical and disaster relief services:
  - a. This work involves refugees or displaced populations.
  - b. The work environment is usually volatile and perhaps hazardous. Personal safety and security are factors that must be considered.
  - c. Survival is a daily issue for the population served.
  - d. Relief work will usually involve more "hands-on" experience.
  - e. Interventions recognize the importance of basic public health principles. By providing safe drinking water, food, shelter, and sanitation, infectious diseases are contained. This ultimately saves more lives than treating illness and injury.
2. Training and the development of health care systems.
  - a. The goal is to create a sustainable program addressing a specific local health problem.
  - b. The goals are accomplished by fostering the independence and professional development of local health care workers.
  - c. Teaching and training will be the primary activities.
  - d. The work environment is more stable.
    - (1) The survival of the population is not immediately threatened.
    - (2) The environment poses fewer threats to personal safety.
  - e. The projects are long-term in nature. Individuals looking to make an immediate impact may be frustrated.

3. **An expert consultant**

- a. Provide consultative services to local governments, medical schools, international agencies, and professional organizations.
- b. The task focuses on an organization or institution's response rather than to provide specific care for individuals.
- c. Consultants are usually responsible for producing a written report or grant proposal.
- d. The work environment will vary with the subject being investigated.
- e. Little contact with local populations may be involved. Instead, interaction is likely to be with the most educated and empowered people in the community.
  - (1) Try to recognize and understand the biases of your host.
  - (2) Reflect on how this bias may color your perception of the situation and your subsequent recommendations to any funding source.

4. **Health Care for Westerners.**

- a. The growth of international business and travel has increased the demand for western medical services. Health care provided by English-speaking physicians is in increasing demand around the globe.
- b. Large corporations, international expeditions, film crews, and sports teams may be in need of western medical services overseas.
- c. This work will involve assessing the likely health care needs of the population served and then arranging to have the resources available to deliver this care.

B. What experience or expertise do I have to share?

- 1. Previous overseas relief or development experience
- 2. Teaching experience
- 3. Travel experience
- 4. Foreign language skills
- 5. Applicable medical or surgical skills
- 6. Public health background or training
- 7. Project managerial, grant writing or accounting expertise
- 8. Flexibility, creativity, innovation, cultural sensitivity, organization, tolerance and patience are especially important skills in international work.



### III. Other important issues to consider

#### A. What effect will the decision, to work overseas, have on my personal life?

1. Consider the impact of your decision on your family, spouse, children, and other significant relationships.
  - a. Your decision to work overseas may have a negative impact on those left behind. They may be asked to carry an additional workload.
  - b. Do not be surprised if family, friends and colleagues are less than completely supportive. They have the additional burden of worrying about you while you are away.
  - c. Before departing, consider what will happen if a personal tragedy occurs while you are away. Try to anticipate how you will feel if personal problems arise. Talk with your family about these issues. Consider the following.
    - (1) Family death
    - (2) A major or life threatening illness
    - (3) Marital or relationship problems
  - d. Don't expect a triumphant return.
    - (1) Many of your significant others will not understand why you went to work overseas in the first place.
    - (2) Many may be harboring resentment of your freedom or perceived irresponsibility.
    - (3) Their lives will have gone on "without you" while you were away.
    - (4) Remember: other's ability to look at travel photos is exhausted in about five minutes.

#### B. What are the financial costs to working overseas?

1. The decision to work overseas is a costly one especially for most physicians. It involves more than the loss income while not working. Consider carefully the financial implications of your decision. Be aware of the hidden costs identified below.
  - a. Will the decision require a change of jobs to get the necessary time off? Changing jobs is an expensive undertaking. Hidden expenses may include the following.
    - (1) Loss of seniority
    - (2) The loss of vested retirement savings
    - (3) Payment of a malpractice insurance tail
    - (4) Loss of health, disability and life insurance
    - (5) Relocation expenses
    - (6) Expenses related to any subsequent employment search

2. Even if you can get a leave of absence or use vacation time, be prepared for extra hidden expenses.
  - a. Does your **health insurance** provide overseas coverage? Are you covered if you receive an injury or illness in a war zone or region that the U. S. State Department has designated as not safe for Americans to travel?
  - b. Are evacuation expenses covered by your health insurance policy? Will the maximum payment cover the cost of an international medical transport to an appropriate health facility in case of overseas injury or illness? If not, consider **evacuation insurance**.
  - c. Will your health insurance pay an international claim directly? Local law may demand cash payment for emergency medical care before you are allowed to leave the country. Will you be reimbursed by the insurance company?
  - d. Will your **disability insurance** pay your claim if the injury occurs in a war zone or a region that the U. S. State Department has designated as unsafe for Americans to travel?
3. Anticipate a short term cash flow problem upon your return.

**C. How will the decision, to do international medical work, affect my professional life?**

1. Will your employer support or discourage this type of activity? Have others within the organization undertaken similar activities in the past?
  - a. The support of your current employer will often dictate whether you can accomplish your goal without changing jobs. Consider taking a sabbatical or a temporary leave of absence, if you want to avoid changing jobs.
  - b. Try to determine ahead of time if international medical work will be viewed positively, negatively or as neutral in the promotion review process.
2. Spending extensive periods outside the United States may adversely affect medical licensing, hospital privileges, and your ability to meet mandated CME requirements.
3. Remember to contract your medical malpractice insurance company to advise them of your change of status.
4. Your decision to "abandon" work at home to undertake an international adventure may strain your relationship with co-workers. Try to anticipate this problem. Address the issue in an open forum especially when returning to the work same environment.

#### **IV. Now what do I do?**

- A. Increase your knowledge base.
  - 1. Attend an international medical conference.
  - 2. Peruse the medical literature.
  - 3. See the Internet/World Wide Web.
  - 4. Investigate Schools of Public Health with International Medicine programs.
  - 5. Join an organization that sponsors volunteer health care workers overseas.
  - 6. Investigate NGOs that are recruiting for overseas positions.
  - 7. Talk with your colleagues (opportunities are spread by word of mouth).
  - 8. Contact your professional societies to see if they sponsor any programs in other countries.
  - 9. Read international newspapers and magazines.

#### **V. The search for a sponsoring organization.**

- A. Agencies or organizations involved in international medical work
  - 1. Large multi-national aid organizations
    - a. Major players in international health.
    - b. Usually reserved for individuals with extensive international health experience
    - c. Geared towards the individual who seeks a career in international health
    - d. Examples include agencies such as WHO, UNICEF, UNHCR.
  - 2. Non-Governmental Organizations (NGOs)
    - a. Smaller, non-profit, religious and non-religious affiliated agencies involved in international relief and development.
    - b. Each agency will have its own support and consultant staff. Their job is to identify specific relief or developmental projects and then to secure the financial support for the project from a funding agency.
    - c. The sponsoring organization will arrange any licensing required for you to practice medicine in the host country.
    - d. The organization provides logistical support including:
      - (1) equipment, medical supplies and teaching materials
      - (2) arranging for housing, food and local transportation
      - (3) handle security issues, including international communication and emergency evacuation
    - e. Examples of NGOs include the following: Medecins Sans Frontieres (MSF), International Medical Corp (IMC), American Refugee Committee (ARC), World Vision.

- B. The single best resources for information about any specific project or its sponsoring organization are former workers who have recently returned from the host country and were involved in the project that you are contemplating**

## **REFERENCES**

### **Organizations that Assist In Placement**

National Council on International Health  
1701 K Street, NW, Suite 600  
Washington, DC 20006  
(202) 833-5900

Health Volunteers Overseas  
c/o Washington Station  
P.O. Box 65157  
Washington, D.C. 20035-5157  
(202) 296-0928

Project Concern International  
Options Program  
3550 Afton Road  
San Diego, CA 92123  
(619) 279-9690

### **Non-Governmental Organization (Agencies Involved in International Medical Work)**

"Physician Service Opportunities Abroad" JAMA 270:5 (93) 567-571

### **Personal Health Information**

Summary Of Health Information for Travelers  
Department of Health and Human Services  
Public Health Service  
Centers for Disease Control  
Atlanta, GA 30333

CDC Travelers Health Hotline (404) 332-4559

International Association for Medical Assistance to Travelers  
417 Center St.  
Lewiston, NY 14082

#### **Evacuation Insurance**

Access America International	(800) 284-8300
Air Ambulance Professionals	(800) 752-4195
Gateway International	(800) 424-9801
International SOS Assistance	(800) 523-8930

#### **Health Insurance Abroad**

Wallach and Company, Inc.  
243 Church Street, NW  
Suite 100D  
Vienna, VA. 22180

#### **NOTES**

**BOSNIA: THE IMPACT OF WAR ON MEDICAL CARE**

Ronald Ruffing M.D., MPH.  
Assistant Professor of Emergency Medicine and Pediatrics  
Tufts University School of Medicine  
Boston, Massachusetts

## COURSE OBJECTIVES

Following this presentation, the participants will be able to:

1. List the three major *Narods* central to the conflict in the former Yugoslavia. Identify the territorial claims, religious beliefs and historical alliances of each.
2. Outline the three major tiers of the Bosnian health care system. Know how they related to provide medical services before the war.
3. List four major long term impacts of the war on medical care delivery.
4. Identify several strategies to encourage organizational change in how we deliver medical care.

## **BOSNIA: THE IMPACT OF WAR ON MEDICAL CARE**

### **I. INTRODUCTION**

- A. War in Europe Again! The unimaginable happens.
- B. "Ethnic Cleansing" in Europe.

### **II. HISTORICAL OVERVIEW OF THE WAR**

- A. War of Maps
  - 1. Yugoslavia before the current crisis. (FIGURE 1)
  - 2. Greater Serbia (FIGURE 2)
  - 3. Greater Croatian (FIGURE 3)
- B. War of *Narods*
  - 1. Serbs
  - 2. Croatsians
  - 3. Muslims
- C. The developing crisis in Bosnia-Hercegovina
  - 1. Rise of nationalism
  - 2. Democracy, free elections and international recognition
  - 3. Bosnia caught in the middle
- D. The world responds
  - 1. United States
  - 2. European Community

### **III. MEDICAL CARE IN THE FORMER YUGOSLAVIA**

- A. Medical care in the former Yugoslavia was based on a tiered system that emphasizing primary health care:
  - 1. Locally-based, primary care services
  - 2. District-based, outpatient, specialty, and urgent care services
  - 3. Regionalized, specialty and hospital-based medical care



- B. Medical education in Bosnia-Herzegovina before the war:
1. Medical University
    - a. Six years
    - b. Traditional pre-med and medical school courses.
    - c. Schools located in Tuzla, Sarajevo, Banja Luka.
    - d. Approximately 400 students each year.
    - e. Admission based on "high school" competency exam.
  2. Hospital-based supervised training.
    - a. One year
    - b. Rotating, in-hospital "internship"
  3. Primary care service obligation
    - a. Two years of service in general medical practice.
    - b. Provide outpatient care in the "ambulantas".
    - c. Medicine with "a stethoscope and ten fingers".
    - d. After two years, a physician may apply for a permanent primary care position or seek specialization.
    - e. Appointments for specialization are made by the regional health minister.
  4. Postgraduate specialty care training
    - a. Four to five years of additional training.
    - b. Training takes place at the regional hospital.
    - c. Appointment is based upon a complex interplay of factors: past performance, political associations, and the projected health needs of the region.
    - d. The appointment process is under the authority of the regional health minister.
- C. The organization of regional health services: Zenica Regional Hospital
1. Referral process
    - a. Patients must be evaluated by a referring physician to be seen at the regional medical center.
      - (1) A primary physician may refer a patient directly to a specific specialty service.
      - (2) An ambulance-based physician may transport a patient directly to a specific specialty service.
      - (3) After-hours, ambulatory care centers (staffed by physicians) may refer patients to the regional hospital for admission or specialty evaluation.

2. Receiving rooms
  - a. Specialty-based entry points to the regional hospital
    - (1) internal medicine
    - (2) pediatrics
    - (3) general surgery
    - (4) traumatology (Orthopedics)
    - (5) neuro-psychiatry (neurology/neurosurgery/psychiatry)
    - (6) urology
    - (7) infectious disease
    - (8) ENT
    - (9) ophthalmology
    - (10) gynecology
  - b. Emergency patients, non-emergency new patients, and clinic follow-up patients are evaluated in the same place.
  - c. No triage system exists. Patients line up each morning in the hall and are evaluated on a first-come, first-serve basis.
  - d. Patients who require the opinion of more than one specialist, are wheeled between the different specialty receiving rooms to see different speciality physicians.
3. Emergency resuscitation
  - a. No single resuscitation area exists
  - b. Immediate surgical cases are often initially evaluated in the hallway between the operating room and the intensive care unit.
  - c. The department of anaesthesiology manages the intensive care unit. They are the physicians most skilled in "reanimation".
  - d. Airway management is specifically a skill reserved for the department of anaesthesia.

#### IV. IMPACT OF THE WAR ON MEDICAL SERVICES

- A. Changes in patient care services:
  1. Marked increase in traumatic, war related injuries.
  2. The influx of refugees has increased the demand for services.
  3. Medical supplies are a scarce resource. The civilian population's health care needs become a secondary concern. The results are an inadequate quantity and the mal-distribution of medical supplies.
  4. Loss of experience and expertise by providers.
    - a. Conscription - drafting of physicians into the military
    - b. Emigration - flight of professionals out of the country

- B. Physicians in Training
  - 1. Disruption of Medical Schools
    - a. Flight of the faculty and students
    - b. Loss of educational facilities and equipment
    - c. Military Obligation
  - 2. Disruption of In-Hospital Specialty training
    - a. Lack of skilled physician educators
    - b. No training materials - textbooks, journals, equipment
    - c. Shift to military medicine needs.

V. **INTERNATIONAL MEDICAL CORPS'S EMERGENCY MEDICAL RELIEF PROJECT IN CENTRAL BOSNIA.**

- A. **Initial assessment and project development**
  - 1. Two site visits to assess the disruption of emergency medical services in central Bosnia. (Nov 92 and March 93)
    - a. Problems identified
      - (1) Pre-hospital Services
      - (2) Physician education and experience with traumatic injuries.
- B. **Phase 1: Emergency Medicine Training Course (Summer/Autumn 93)**
  - 1. Physician course: ATLS, ACLS, PALS.
  - 2. Non-physician course: EMT-Paramedic courses
  - 3. Resource assessment
  - 4. Resource allocation
- C. **Phase 2: Introducing Emergency Room Care (Winter/Spring 94)**
  - 1. Pre-hospital care: ambulance program
  - 2. Hospital-based care
    - a. Emergency room development program
      - (1) nursing training
      - (2) physician training
- D. **Phase 3: Emergency Department Development (Summer 94-present)**
  - 1. Pre-hospital Care
    - a. Local operation of the pre-hospital care system
  - 2. Emergency Department
    - a. Renovation, construction and funding.
    - b. Specialization and recognition of expertise.
    - c. Supervised patient care and physician in training education
    - d. Development of emergency nursing care

## **.VI. INTEGRATION OF EMERGENCY MEDICINE**

- A. Conflicts within the Zeneca Regional Hospital over emergency care
  - 1. Why Change the way we've always done things?
  - 2. Anesthesiologists are the only physicians who can intubate!
  - 3. Which patients are suitable candidates for resuscitating?
  - 4. Bring the patient to me!
  - 5. The IMC emergency room
  - 6. Who's in charge of the patient.
- B. Problems
  - 1. Changing health delivery system.
  - 2. Questioning standard practices
  - 3. Undermining the Expert Authority
  - 4. Financial implications of emergency department project.
- C. Solutions
  - 1. Building sustainable systems
  - 2. Empowering local physicians
  - 3. Teaching new ways of teaching
  - 4. Handing off program control to local agencies
  - 5. Monitoring outcomes

## **VII. INSIGHTS INTO INTERNATIONAL MEDICAL RELIEF WORK**

- A. Identify your personal goals.
- B. Recognize the goals of the sponsoring agency:
  - 1. obligations to **local authorities**
  - 2. obligations to **funding sources**
- C. Be aware of your impact on local providers of your service.
- D. What will happen when the goodies run out?
- E. Disillusionment: Why can't I accomplish anything?
  - 1. Bureaucracy and Red Tape
  - 2. Fear of change
  - 3. Poor project goals
  - 4. Unrecognized political, economic, cultural, religious barriers

## **VIII. WOULD I DO THIS AGAIN?**

## REFERENCES

### **Balkan Peninsula history, Geography, Politics**

1. Kaplan, Robert D. *Balkan Ghosts, A Journey through History*. New York: Vintage books March 1994
2. Gutman, Roy. *A Witness to Genocide*. New York, Macmillan, 1993.
3. Glenny, Misha. *The Fall of Yugoslavia*. New York, Penguin Books, 1993
4. Vulliamy, Ed. *Season's in Hell*, New York, St. Martin's Press, 1994

### **Emergency Medical Relief Work**

5. Brennan RJ., et.al., "Medical Relief in Central Bosnia." *The Medical Journal of Australia* 161 (94), 675-679,
6. Goldstein R. (Letter) *NEJM* Dec 2, 1993

### **Physician Services: Agencies Involved in International Medical Work**

7. "Physician Service Opportunities Abroad" *JAMA* 270:5 (93) 567-571

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Wednesday, August 9, 1995

**DECISION MAKING IN  
MOUNTAIN RESCUE:  
CASE STUDIES**

*Mountain Rescue Aspen*

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## **DECISION MAKING IN MOUNTAIN RESCUE:**

### **CASE STUDIES**

#### **Mountain Rescue-Aspen**

- Following this workshop participants will gain an understanding of the considerations in the decision making process in a selection of actual rescue situations.
- Discussions will focus on the following aspects:
  - technical
  - medical
  - environmental

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Wednesday, August 9, 1995

**DECISION MAKING IN  
ALTITUDE ILLNESS:  
CASE STUDIES**

*Peter Hackett, MD*

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*Case studies will be distributed during the workshop.*



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Wednesday, August 9, 1995

# MOUNTAIN BIKE SAFETY

*Lily Conrad, MD, PhD, FACEP*

## Mountain Bike Safety

Lily Conrad, PhD, MD, FACEP

Emergency Medicine  
Denver, Colorado

Mountain biking is unique  
    far from road, remote quite quickly, poor motorized vehicle access, long way to phone  
    carry little gear compared to hikers  
Medical literature on mountain biking: very little  
    nothing yet on comparison of injuries with mountain versus road bikes  
General safety and hazards  
    The bike- maintenance, tires, brakes  
    You- equipment, helmet and gloves, glasses  
        ability and limits  
        safety in group, numbers- don't go alone  
Terrain- altitude, ascent with exertion, water, rocks  
    Lost: map-reading ability, avoiding cliffs, out after dark  
Weather- esp Colorado, very changeable  
    HYPO thermia: sudden rainshowers, snow, hail, wind, on descent  
    HYPER thermia: Moab, desert  
    Lightning  
Animals- cougar, bear, rattlesnakes  
First Aid in Field: Trauma and Medicine:  
    Send for help: determine need for evac/ assist transport  
    Improvisation  
        Slings from tube  
        Splint from pump, rack, stick  
    What to carry- first aid kit  
    Water- drinking, washing wounds:  
What can happen: most likely and worst possible  
    Trauma  
        Head injury, LOC  
        Neck pain, C-spine fracture  
        Facial injuries- teeth, mouth, eyes  
        Chest, abdomen, back  
        Extremities- abrasions, road rash, hematoma  
        fractures- FOOSH, clavicle, scapula, ribs, hips  
    Medical: General  
        Allergic reaction      Asthma  
        Diabetes              Cardiac

### References

- Barnett, B. More on mountain biking West J. Med 159 (6):708 1993.
- Chow, T., Bracker, M and Patrick, K. Acute injuries from mountain biking West J. Med. 159:145-148 1993.
- Lovell, M., Brett, M. and Enion, D. Mountain bike injury to the abdomen, transection of the pancreas and small bowel evisceration Injury 23:499-501 1992.

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Wednesday, August 9, 1995

**PAIN MANAGEMENT  
IN THE  
WILDERNESS**

*Anne Dickison, MD*

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# Pain Management in the Field

Anne E. Dickison, M.D.

Director, Pediatric Intensive Care Unit  
Director, Pediatric Transport System  
Dartmouth-Hitchcock Medical Center  
Lebanon, New Hampshire

Assistant Professor of Anesthesiology and Pediatrics  
Dartmouth Medical School  
Lebanon, New Hampshire

Objectives:

A complete anesthetic contains five components: pain reduction (analgesia), pain elimination (anesthesia), immobility/cooperation, psychologic assistance (unconsciousness, amnesia, comfort), and physiologic and mental stress reduction. This workshop will address pharmacologic agents with potential field applications, their benefits and limitations, and will touch briefly on alternatives to pharmacological interventions.

Pain relief is a major consideration for individuals putting together an expedition first aid kit, or responding to emergencies in remote areas. Analgesic agents in most typical expedition first aid kits are limited to aspirin, ibuprofen, topical balms for stings or burns, or may occasionally include oral compounds containing narcotics. Some ambulance or search and rescue response teams are authorized to use intravenous narcotics, sedatives, and anti-psychotics; this varies by state licensing regulations, EMS triage networks, and individual company practices. Morphine is the military standard for analgesia and sedation, while ketamine, lidocaine, diazepam, and droperidol are among the additional anesthetic agents used in combat or circumstances of mass disaster. Regional anesthesia is widely used in many third world countries, and is an important modality for remote locations where surgical care providers have been brought in as part of a medical intervention team.

To be adaptable for field use, pharmacologic agents should be:

- \*Compact and lightweight
- \*Conveniently packaged
- \*Relatively stable during fluctuations of environmental conditions
- \*Need a minimum of additional equipment for administration
- \*Have a broad therapeutic index (toxic and effective doses are very different, so overdose less likely)
- \*Have relatively fewer life-threatening side effects, and antidotes (naloxone, diphenhydramine, flumazenil, equipment for ventilation and/or volume resuscitation) included in the supplies
- \*Relatively less expensive so supplies can be replaced regularly

Just which anesthetic or analgesic agents should go into the medical supplies is dependent on the purpose of the expedition, the skills of the providers, the remoteness from definitive health care, and the types of hazards anticipated in the environment.

## DEFINITIONS

<u>Sedative</u>	Agent which allays activity and excitement
<u>Hypnotic</u>	Agent which induces sleep or drowsiness
<u>Tranquilizer</u>	Agent which calms the emotional state without disrupting clarity of consciousness
<u>Analgesic</u>	Agent used to <u>diminish</u> the perception of pain
<u>Anesthetic</u>	Agent used to <u>abolish</u> the perception of pain
General	Analgesia accompanied by loss of consciousness
Regional	Nerve transmission of the pain sensation is blocked without affecting the level of consciousness

### Neuromuscular blocker

Agent which acts at the neuromuscular junction to paralyze movement and which has no effect on consciousness or the perception of pain

### "Light sedation"

A state of being mellow, tranquil, and calm. The patient may fall into a natural sleep, but can be normally awakened and will respond to mild stimulation appropriately, coherently, and purposefully. Protective reflexes are not compromised.

### "Conscious sedation"

A minimally depressed level of consciousness and sleep state (hypnosis) in which the patient will rouse to moderate physical or verbal stimulation with coherent and appropriate responses, but if left unstimulated will return to sleep. Protective reflexes (blink, cough, withdrawal to pain, etc.) remain intact, though snoring and obstructive sleep apnea may occur in this state.

### "Heavy sedation" or "Deep sedation"

A controlled state of deep sleep (hypnosis) from which the patient is not easily aroused, which may be accompanied by partial or complete loss of protective reflexes, including the ability to maintain an airway or respond purposefully to physical or verbal stimulation.

## Components of Anesthesia

1. Analgesia
2. Unawareness
3. Immobility
4. Amnesia
5. [Sympatholytic]

## Drug Classes Grouped by Action

### Sedatives

Hydroxyzine  
Antihistamines  
Ethanol

### Sedative-Hypnotics

Chloral hydrate  
Barbiturates  
Benzodiazepines  
Nitrous oxide

### Tranquilizers

Benzodiazepines  
Butyrophenones (droperidol)  
Phenothiazines

### Analgesics

Non-steroidal anti-inflammatories  
Narcotics  
Ketamine  
Nitrous oxide

### General Anesthetics

Potent volatiles (gases)  
Ketamine  
Propofol  
Etomidate  
Barbiturates  
Lidocaine (IV)

### Local Anesthetics

Esters (cocaine, procaine)  
Amides (lidocaine, bupivacaine)  
Eugenol (oil of cloves)  
Phenol/menthol  
Camphor  
Cold

### Neuromuscular Blockers

Succinylcholine  
Non-depolarizers  
Ganglionic blockers

### Other

Clonidine  
Hallucinogens  
Hypothermia  
Aloe

## **General anesthetics**

Agents which cause the complete loss of consciousness and lack of response to intensely painful stimuli are called general anesthetics. The public usually associates this term with the concept of going to sleep in the operating room under the influence of a potent volatile agent like halothane or ether. General anesthesia also can be administered intravenously using opioids, propofol, ketamine, certain major tranquilizers, certain barbiturates, etomidate, lidocaine, or some of the benzodiazepines. More commonly, a combination of several of these classes of drugs are used to provide a "balanced anesthesia." While any of the intravenous agents may be adaptable to wilderness situations, doing so is not without significant risk which must be weighed against the alternative options for preservation of life. Because a general anesthetic renders the patient completely defenseless and far more unstable, these agents should be administered in the field only by experienced personnel and when there is absolutely no other alternative.

General anesthesia is sometimes encountered or achieved inadvertently. Overdose of drugs intended for conscious sedation is one example, but we are also familiar with overdoses from alcohol, recreational drugs, exposure to toxins or concentrated vapors, the results of profound hypothermia, or other environmental influences or physiologic responses leading to unconsciousness. Needless to say, if mind-altering drugs (alcohol, for example) are used intentionally to adjunct analgesia or promote a sleep state, the end-point should stop short of stupor and the potential for loss of important protective reflexes.

## **Regional anesthesia**

When the mind remains clear but a portion of the body is rendered numb, this is referred to as regional anesthesia. Spinal, epidural, and caudal anesthetics are examples of regional techniques, but are not easily adaptable to field situations. However, there are a number of other regional techniques and anesthetics that can be very useful for the backcountry situations and expedition medicine. These regional approaches can be grouped further into topical anesthetics, infiltration (field) blocks, and nerve blocks.



The general public is already quite aware that certain balms and potions, when applied to painful places, may afford at least temporary relief. Topical anesthetics can be found in the proliferation of sunburn remedies, hemorrhoid creams, gum soothers, sting and bite reliefs, first aid spray, sore throat lozenges, and burn creams that are sold over the counter, or are used in home remedies or herbal medicine practices.

Topical anesthetics requiring a prescription or a professional contact, but which might be considered for extended expedition contingencies include:

- \*Auralgan Otic Solution (benzocaine)
- \*Viscous Xylocaine 2% (lidocaine)
- \*Topical anesthetic for ophthalmologic use (tetracaine usually)
- \*Local anesthetics for dental use  
(eugenol or oil of cloves; also injectables such as carbocaine, bupivacaine, lidocaine, procaine)
- \*Tetracaine-Adrenalin-Cocaine solution (TAC)
- \*EMLA cream (lidocaine 2.5% and prilocaine 2.5%)
- \*Lidocaine 1%, 2%, or 4% to use in topical solution for road rash, or for tissue and peripheral nerve block injection
- \*Cocaine 4% solution for intense vasoconstriction and topical anesthesia

Conveniently, the generic names of the local anesthetics all end in "caine" and therefore can be identified by class at first sight. Local anesthetics work by blocking nerve transmission, and may block sensory, motor, or sympathetic nerve transmission depending on how the anesthetic is applied or absorbed. Complications are primarily neurologic (seizures, coma, temporary paralysis, respiratory failure, stimulation of vomiting centers) or from neurologically mediated cardiovascular effects (cardiac conduction abnormalities, arrhythmias, vascular relaxation, hypotension). 1, 5, 7, 10

**The spectrum of local anesthetic toxicity**  
ranges, from the lower end:

procaine (Novocaine) → lidocaine (Xylocaine) →  
mepivacaine (Carbocaine) → bupivacaine (Marcaine)  
→ tetracaine → dibucaine (Nupercaine)  
→ cocaine, with the highest toxicity.<sup>1</sup>

Because of this very high potential for toxicity and its low therapeutic index, **cocaine** is not the anesthesiologist's local anesthetic of first choice. If it is available on an expedition when a local anesthetic is being sought, the concentration of solution should be limited to 4% (4 grams per 100 cc, or 40 mg per 1 cc) and the total dosage should be restricted to less than 2 mg per kg. Cocaine in the eye will cause midriasis and cycloplegia, actions which may be either ophthalmologically beneficial or neurologically confusing.<sup>1,5,7,10</sup>

Of the available local anesthetics, lidocaine has one of the best relationships between effective dose and toxic dose, and has numerous potential field applications. In addition to its use for nerve blocks and infiltration anesthesia, it can be used topically on lacerations, abrasions, and to some extent on stings, and can provide excellent anesthesia for painful lesions of mucous membranes. It can also drown insects who have wandered into the ear canal (a highly unpleasant occurrence that will cause the victim to go berserk)<sup>2,3</sup>. Topical or injected lidocaine can be used to facilitate the removal of other foreign bodies as well.

Compared to many other pharmacologic agents used for anesthesia and analgesia, lidocaine is a very "safe" drug. Allergic reactions to it are extremely rare. It is rapidly metabolized and cleared from the bloodstream once it gets there. Other than its anesthetic effects on nerve conduction in both the peripheral and central nervous systems, and the neurologically-mediated effects on the cardiovascular system, it does not have other serious end-organ toxicities.<sup>1,5,7</sup> It travels well and maintains stability when subjected to the extremes of temperature and humidity encountered on expeditions.<sup>10</sup>

### **Infiltration anesthesia**

This technique is particularly helpful to facilitate the thorough cleaning or debridement of a wound, or for exploration for retained foreign bodies. Infiltration anesthesia may also be employed to suture lacerations, drain abscesses, or place incisions (e.g., chest tube insertion) if these surgical interventions are undertaken.

Using a long but small gauge needle, Lidocaine 0.5% to 1% can be injected into the subcutaneous or muscular tissues surrounding the tissue injury. The addition of epinephrine to the lidocaine solution will slow down absorption and prolong anesthesia, and will permit an increased total dosage of lidocaine before toxicity might be expected. Without epinephrine, total lidocaine dosages should be kept less than 5 mg/kg. With epinephrine, total lidocaine dosage might be increased to 7 mg/kg.<sup>1,6,7,10</sup>

Epinephrine-containing solutions usually come in dilutions of 1:100,000 (10 micrograms per cc) and 1:200,000 (5 micrograms per cc). Epinephrine effects include hypertension, cardiac arrhythmias, "fight or flight" responses, tremors, and extreme vasoconstriction leading to gangrene.<sup>1,5,6,7,10</sup> Susceptibility to epinephrine effects varies with the patient and the clinical circumstances. Epinephrine should not be used for infiltrative or nerve block anesthetics involving the digits, penis, ears, or nose, or any time that circulation to the area looks compromised. It should also be used with caution in highly vascular areas (e.g., the pleura) or in infected areas where drug absorption might be enhanced.<sup>1</sup>

### **Nerve blocks**

There are a number of nerve blocks that are extremely useful for dealing with medical emergencies that might occur in remote areas, and the individual traveling in the capacity of medical care provider might wish to become familiar with the techniques. Examples of some of these more complicated but especially useful peripheral nerve blocks include:

- |   |                                      |
|---|--------------------------------------|
| intercostal (broken ribs)                                       | dental (for extraction and drainage) |
| pudendal (childbirth)   | axillary (significant arm problems)  |
| femoral (femur traction)  | penile (trauma, priapism)            |
| ilioinguinal/iliohypogastric (hernia reduction, scrotal trauma) |                                      |

### Digital blocks

Technically, the digital block is very easy to perform, and the resultant anesthesia is profound. The digital block may be used for setting digital fractures, removal of traumatized nails, drainage of subungual hematomas or abscesses, drainage of felons or deep paronychias, removal of large splinters or other foreign bodies, cleansing or suturing of lacerations, coping with a crisis of gouty arthritis, removal of constricting rings, freeing digits that are painfully caught somewhere, or many other painful conditions of the fingers or toes. However, in conditions in which the circulation to the digit may be compromised, as in frostbite, snakebite, or extensive crush injuries with swelling, the technique should be used with caution if at all.

To perform a digital block one needs  
lidocaine 1% or 2% (without epinephrine)  
3-cc or 5-cc syringe  
25-gauge needle  
and alcohol or Betadine to prep the skin.

A larger needle like an 18-gauge is handy to use to draw up the lidocaine into the syringe, but it is not essential for the procedure.

One does not want to stick the needle into the bone or into the arteries that run close to the bone on either side of the digit, but all adjacent territory is acceptable. Looking at a cross section of a finger or toe as a clock face, the 4 digital nerves are located at 2:00, 4:00, 8:00, and 10:00. Two needle sticks are required, one on either side of the digit. The level of puncture is at the web of the digit. The needle enters at 1:00 to 2:00 and at 10:00 to 11:00, with 12:00 being to center topside of the digit. Once it is through the skin, the needle is advanced parallel to an imaginary line drawn between 12:00 and 6:00. The needle is then aspirated to check for blood, then one to three cc of lidocaine is/are injected on both sides of the digit.<sup>1,4,6</sup> Sometimes additional anesthesia can be obtained by infiltrating another cc of lidocaine just under the skin over the top of the digit. Making a circle of lidocaine around the digit is not recommended because this has the potential for impairing circulation.

An intravascular, intraosseous, or intra-arterial injection of lidocaine is not advisable, but it is not disastrous either. A toxic level of lidocaine in the arterial circulation can cause seizures, loss of consciousness, and hypotension.<sup>1,5,6,7,10</sup> The total dose of injected lidocaine should be limited to no more than 5 mg/kg in the event of an intra-arterial injection. One cc of 1% lidocaine has 10 mg in it. In a 70 kg man, the upper limits of a "safe" dose would be 350 mg, or 35 cc of lidocaine 1%. In the volumes used for a digital block, even with a direct intra-arterial injection, toxic levels are not even remotely approached. As was mentioned before, epinephrine should not be added to the local anesthetic used for digital blocks.

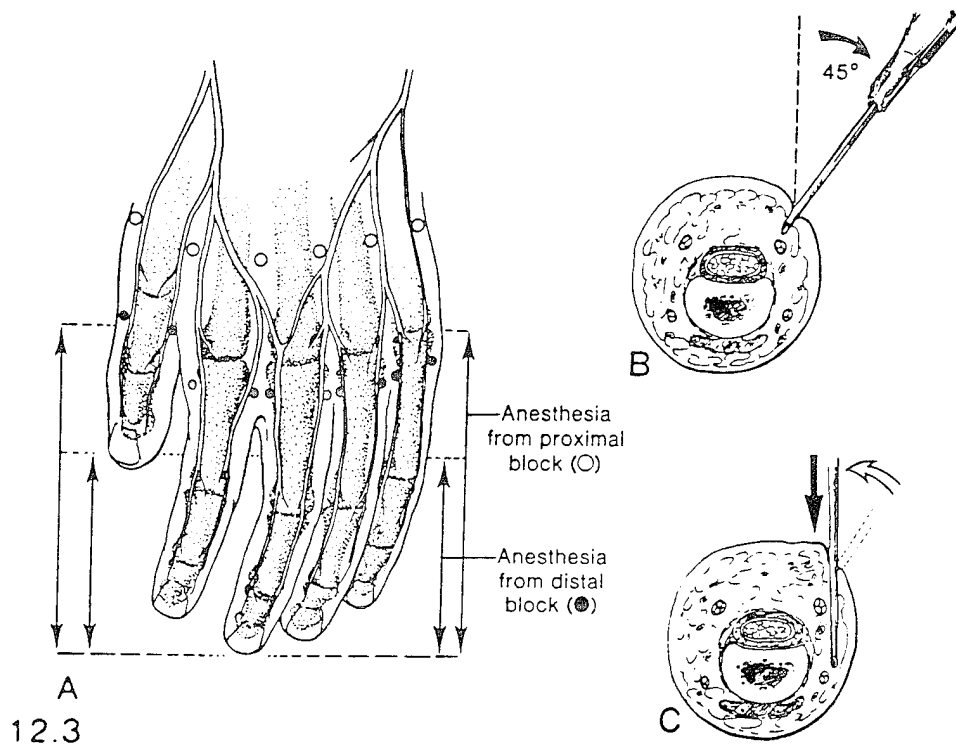


illustration from Fleisher and Ludwig, p. 1276<sup>4</sup>

#### Drainage of subungual hematomas or abscesses

Drainage of a hematoma or collection of pus from a nailbed often provides so much relief in and of itself that anesthetic supplementation with a digital block is unnecessary. A small drainage hole through the nail can be achieved by augering through the nail with the point of an 18-gauge needle or one of the pointier blades of the Swiss Army knife, or even more efficiently, by burning through the nail with the tip of a heated unfolded paper clip.<sup>2,3,4</sup>

### **Non-pharmacologic anesthetics**

Sometimes physiologic influences which have anesthetic properties can be adapted to field situations. Application of cold compresses to the pain of stings, small burns, sprains, abrasions, etc. is quite helpful. Judicious application of pressure (e.g., acupressure, or application of pressure to nerves to induce strategic parasthesias), temporary elimination of circulation resulting in numbness, and the application of intense cold short of freezing are practices which may facilitate the doing of painful procedures. Covering abrasions, burns, scratched corneas, and areas of inflammation, etc. from further irritant influences (wind, light, sun, etc.) can reduce new barrages of pain signals while promoting the necessary protection for healing.

## **Analgesics**

### **Nonsteroidal anti-inflammatory drugs (NSAIDs)**

Tissue injury results in the cellular release of chemical mediators like histamine, bradykinin precursors, and arachidonic acid. A chemical chain reaction takes place which results in stimulation of the sensory nerve endings. NSAIDs inhibit prostaglandin production (and therefore initiation of certain pain signals) by interruption of the cyclo-oxygenase pathway of arachidonic acid metabolism. Because prostaglandins are present throughout the body and function in multiple roles, the effects of the NSAIDs are not confined to analgesia. Except for anaphylaxis, the potential for adverse effects is increased with higher doses and longer duration of usage.

The most serious adverse events associated with the NSAIDs are: <sup>5,6,10</sup>

- \*Gastrointestinal ulceration, bleeding, and perforation
- \*Inhibition of platelet aggregation and prolongation of bleeding time
- \*Fluid retention
- \*Diminished vision, scotomata, or changes in color vision
- \*Renal effects including papillary necrosis, interstitial nephritis, hematuria, proteinuria, reduction in renal blood flow, and renal insufficiency
- \*Chemical hepatitis
- \*CNS: spectrum from insomnia and vivid dreaming to lethargy; headaches, dizziness, tremors, convulsions
- \*Potential for competition with other drugs (coumadin, lithium, furosemide, and thiazides: the drugs most commonly encountered)

### **Ibuprofen** <sup>10</sup>

How supplied: 200, 300, 400, 600, and 800 mg tablets  
Dosage: Do not exceed 3200 mg per day  
Usual analgesic dose 2400 mg per day  
May take divided doses every 4, 6, or 8 hours  
Stability: Melting point 74-77 degrees Centigrade.

### **Indomethacin (Indocin®)** <sup>10</sup>

How supplied: 25, 50 mg capsules  
75 mg Indocin SR capsules  
Dosage: 25 mg capsules t.i.d. or 75 mg indocin SR q.d.  
50 mg capsules t.i.d. or 75 mg indocin SR b.i.d.  
Do not exceed total daily dose of 200 mg.  
Toxicity: Nausea, vomiting, intense headache, mental confusion,  
lethargy, dizziness, convulsions  
Stability: Practically insoluble in water

### **Diflunisal (Dolobid® Tablets)** <sup>10</sup>

Diflunisal is a NSAID, non-narcotic derivative of salicylic acid with a long duration of action and equipotent analgesia to acetaminophen 650 mg with propoxyphene napsylate 100 mg (Darvoset® N-100), and acetaminophen 600 mg with codeine 60 mg (2 tablets of Tylenol #3®).

How supplied: 250 and 500 mg tablets  
Dosage: Load with 1000 mg, then 250-500 mg B.I.D.  
Not to exceed 1500 mg/day  
Toxicity: Nausea, vomiting, diarrhea, headache, tachycardia,  
hyperventilation, sweating, tinnitus,  
disorientation, stupor, coma  
Stability: Very high melting point, practically insoluble in water

### **Ketorolac tromethamine (Toradol®) 9,10**

How supplied:	15 mg in 1cc (1.5%), 30 mg in 1 cc (3%) , 60 mg in 2cc (3%) for injections (Cartrix syringe, or Tubex cartridge- needle unit)
	10 mg tablets
Dosage:	30 mg or 60 mg IM loading, followed by 15-30 mg IM q6h Maximum dose 1st day is 150 mg, followed by 120 mg/day thereafter. Not to be used longer than 5 days. 10 mg tablet q 4-6 hours for a limited duration of time
Stability:	Tablets should be stored in temperatures of 15-30 degrees C. (59-86 degrees F.) and protected from light and humidity. Shelf life of tablets exposed to humidity is 18 months (versus 24 months if sealed) IM product has been stored up to 6 weeks in temperature ranges of 5-60 degrees C. IM product is oxygen- sensitive and breaks down if exposed.

### **Opioids**

Because of the opioid effect on the respiratory drive, especially at altitude or when there may be other respiratory depressants on-board, this class of drug should be reserved for desperate circumstances. Naloxone (Narcan®) should be included in any medical kit that includes an injectable opioid, even of the agonist-antagonist variety like Talwin®, Nubain®, or Buprenex®.

If included in the medical kit, the choice of injectable opioids, in my opinion, should be limited to morphine or meperidine (Demerol®). Fentanyl and its relatives have much greater potential for respiratory depression and loss of airway protection, are expensive, and do not do as well as sedative-hypnotics compared with either of the other two opioids mentioned. Sedation and relaxation for extrication or evacuation may be an important feature of acute pain management in wilderness emergencies. As an aside, while fentanyl is available as a transdermal patch, it has no role in the management of acute pain because the onset of analgesia is delayed by hours from patch application, and the intensity of the analgesia may be erratic.

Oral opioids to consider for the supplies might include straight codeine or codeine compounds, oxycodone compounds (Percodan®, Percoset®),



meperidine (Demerol®), or MS Contin®, the new oral formulation of morphine. The opioid agonist-antagonists also come in oral preparations.

## "Sedation," Hypnosis, and Anti-psychotics

There are few wilderness emergencies where the need for pharmacologic sedation or sleep supersedes the call for analgesia; often if the pain is eased, and non-pharmacologic comfort is provided, the person will calm or fall into a natural sleep on his own. Psychiatric emergencies are a different story, however, since irrational or violent behavior could jeopardize not only the victim, but all other members of the expedition.

**Major tranquilizers** with field potential include chlorpromazine (Thorazine®), droperidol (Inapsine®), and haloperidol (Haldol®). All three can be delivered intramuscularly and take effect reasonably quickly. The expedition medic should become familiar with the doses and effects of these drugs prior to their administration, and should be aware that the recipient may become incapacitated and incapable of self-expression or meaningful behavior (like walking on a trail) for a number of hours after the emergency pharmacologic intervention.

### **Minor tranquilizers: the benzodiazepines**

In addition to their sedative, anxiolytic, and anti-depressant effects, this class of drugs offers two other attributes which may be desirable for an expedition: amnesia for unpleasant events (like reduction of fractures and dislocations), and anti-convulsant activity. Some of the benzodiazepines are more sedative-hypnotic, and others are more anti-convulsant or suitable for relaxant adjuncts for painful procedures. The expedition medic should consider what is to be achieved in choosing which, if any, to include in the medical supplies, and should be aware that none of the injectables stand up very well to environmental stresses.

The three I would consider most useful in the field would be: midazolam (Versed®), lorazepam (Ativan®), and diazepam (Valium®).

**Benzodiazepines are divided into three groups  
on the basis of elimination half-life <sup>7</sup>**

**Ultrashort-acting (< 10 hours)**

Triazolam	(Halcion)	1.7 - 3 hours
Midazolam	(Versed)	2 - 5 hours
Temazepam	(Restoril)	10 hours

**Short-acting (10 - 24 hours)**

Alprazolam	(Zanax)	11 - 14 hours
Lorazepam	(Ativan)	10 - 20 hours
Oxazepam	(Serax)	3 - 21 hours

**Long-acting (> 24 hours)**

Chlordiazepoxide	(Librium)	5 - 30 hours
Chlorazepate	(Tranxene)	36 - 200 hours
Clonazepam	(Clonipin)	10 - 50 hours
Diazepam	(Valium)	20 - 50 hours
Flurazepam	(Dalmane)	50 - 100 hours

	<i>Equivalent dose (mg/kg)</i>	<i>Volume of distribution (Liters/kg)</i>	<i>Protein- binding (%)</i>	<i>Clearance (ml/kg/min)</i>	<i>Elimination half-life (hours)</i>
Diazepam	0.3-0.5	1-1.5	96-98	0.2-0.5	21 - 37
Midazolam	0.15-0.3	0.95 -6.6	96-98	6-8	1.2 - 12.3
Lorazepam	0.05	0.8-1.3	96-98	0.7-1	10 - 20

In an emergency, the injectable form of all three of these (diazepam, lorazepam, midazolam) can be administered, with moderately good bioavailability, per rectum.

Midazolam can be given intramuscularly (at a dose of 0.07-0.08 mg/kg) with an onset of action of about 15 minutes and peak in about an hour. <sup>7,8</sup> Unlike diazepam, it can be mixed in the same syringe with low doses of opioids.<sup>8</sup>

Used alone, lorazepam and midazolam have little respiratory depression.<sup>5,7,10</sup> However, when combined with other respiratory depressants (opioids, barbiturates, alcohol, etc.), all the benzodiazepines may precipitate apnea, and may lead to hypoventilation and shifts in the carbon dioxide response curve.<sup>5,7,9,10</sup>

The benzodiazepines have no analgesic effect of their own, and are usually used in combination with opioids or other anesthetics or analgesics when used for amnesia and sedation during painful procedures.

## Summary

### THE GOALS OF FIELD ANESTHESIA / ANALGESIA

- \*To provide pain relief without incapacitating the patient
- \*To maintain a functional mental status
- \*To avoid worsening the injury with the anesthetic
- \*To avoid destabilizing side effects and toxicities

How to best manage pain in an out-of-hospital setting an important but somewhat controversial subject. Which pharmaceuticals to include in the medical arsenal is dependent on the experience of the provider, the purpose and location of the expedition, and the types of medical emergencies anticipated. In addition to possessing the desired effects of analgesia, anesthesia, relaxation, or stress reduction, the drugs chosen for a medical kit should be compact and conveniently packaged, require little additional equipment for administration, have a favorable relationship between effectiveness and toxicity, and should be resilient to the environmental stresses and fluctuations of temperature, humidity, and light. Analgesics and anesthetics should be chosen individually for each expedition, and the products should be kept current because environmental conditions will accelerate their aging and decomposition.

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Wednesday, August 9, 1995

# HUNTING INJURIES

*Mel Otten, MD*

## HUNTING INJURIES

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Following this lecture the participant will be familiar with the common injuries associated with hunting and methods of preventing them as well as understanding the principles of ballistics and wounding potential of various hunting instruments.

Hunting is a popular pastime in the United States although few people still depend on hunting as their primary source of food or income. There were 30 million hunting licenses sold in the United States in 1988 and hunters spend 16 million visitor days just in the National Forests. The North American Association of Hunter Safety Coordinators reported 860 fatal hunting injuries during the four year period 1983-1986. Many of the injuries that are seen are similar to those noted in fisherman, backpackers, and canoeists; namely sunburn, frostbite, cuts, sprains, burns and fractures. Most of these types of injuries go unreported and reliable data is not available. Many injuries occur not while hunting but before when preparing equipment or afterwards when cleaning game. Firearms and arrow injuries often occur while transporting loaded weapons, cleaning weapons or in the process of loading or unloading weapons. Standard firearm and bow and arrow safety guidelines prevent injuries such as these when they are followed. Simple rules such as never pointing a weapon at anything you do not intend to shoot or never drink or take drugs while

using a firearm seem like common sense, but not following them has caused many accidents. Hand lacerations commonly occur while cleaning game often due to hands slippery with blood and guts and improper use of tools. Specially designed gloves that hold slippery game and protect hands from sharp blades can prevent most of these injuries.

Specific injuries that are noted are falls from deer stands, which may account for most of the serious injuries in deer hunters and probably accounts for 20% of the fatalities. The types of injuries are similar to those seen in any fall; spine, pelvic and extremity fractures but also may be complicated by the hunter falling on unsheathed arrows or discharging a firearm upon landing. Tree stand injuries can be prevented by following a few simple rules: First, always wear a safety harness while climbing to or from a stand and while in the stand. Second, never carry a weapon while climbing. Third, if using a homemade stand, make sure your stand is well constructed.

Wilderness injuries unique to hunting involves the types of weapons used for hunting. Arrows are designed to kill by cutting blood vessels and causing hypovolemic shock. They must be razor sharp in order to penetrate deep enough to strike large blood vessels, heart and lungs. Injuries occur when hunters fall on arrows that they are carrying in preparation for shooting or when they are removing or replacing arrows in the quiver. Hunters seldom shoot another hunter with an arrow accidentally because the range at which bow hunting takes place is usually shorter than firearm ranges and the hunter can identify the target. Lacerations, often deep, and occasional embedded arrows are the most likely injury. Lacerations should be treated the same as from a knife or glass, with bleeding control a priority. Embedded arrows should be left in place, if possible, and the patient transported to a medical facility. If the patient cannot be easily

transported with the arrow in place , then the arrow should be cut off two inches above the skin and stabilized in place with gauze and tape.

Firearms are designed to cause injury in game by crushing and tearing tissue rather than cutting. The amount of energy available is much greater than with arrow injuries, depending on the type of firearm, the type of bullet, the powder charge, and the distance at which the projectile has travelled before striking the victim. The most critical element is not the energy but the type of tissue that is struck. A person shot in the thigh with a large calibre weapon at close range may have a relatively minor injury while a person struck in the head with a small fragment may be fatally injured. Priorities of treatment for firearm injuries include airway, breathing, bleeding control and spine and extremity immobilization. The victim should always be disarmed in order to prevent possible injury to the rescuer. If the rescuer does not know how to make the firearm safe, then simply removing it from the vicinity of the victim and pointing the muzzle in a safe direction would be adequate. Any firearm injury has the potential for loss of life or limb and immediate transportation to a medical facility is indicated. Chest injuries may require needle or tube thoracostomy and all abdominal wounds require a laparotomy or laparoscopy. MAST or PASG have been shown not to be beneficial for penetrating trauma and should not be used. Intravenous fluids may be beneficial but bleeding control is the key to survival with blood or fluid replacement after the bleeding has stopped. Antibiotics are probably indicated with abdominal wounds and wounds involving fractures. Wound debridement is best done in the operating room. Up to date tetanus immunization is mandatory for all hunting injuries, especially from firearms.



There have been several attempts to minimize hunting injuries through education and prevention. The Boy Scouts of America, the National Rifle Association, and the North American Association of Hunter Safety Coordinators have trained millions of hunters in hunting safety. Many states require a hunter safety course prior to receiving a hunting license. Wearing international orange colored clothing, using safety harnesses in tree stands, identifying a target before shooting and not consuming alcohol would eliminate many needless injuries and deaths.

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Wednesday, August 9, 1995

**NON-FREEZING  
COLD INJURIES**

*Murray Hamlet, DVM*

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NON-FREEZING COLD INJURIES

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(Objectives and Text to Follow)

## LEARNING OBJECTIVES

Following this presentation, participants will be able to:

- recognize and prevent non-freezing cold injuries, and
- understand the pathophysiology of non-freezing cold injuries.

## NON-FREEZING COLD INJURIES

Chilblain, Pernio, Trenchfoot, immersion foot

Cold urticaria - cold-induced paresthesia, Raynaud's Disease, cold-induced asthma

The severity is determined by the degree of cold, the duration of exposure, and the wetness of the tissue. Modifiers of this injury are fatigue, individual variability, nutrition and clothing. The pathogenesis involves cold-producing vasoconstriction, ischemia and decreased cell metabolism. Wetness increases conductive heat loss and changes membrane permeability with changes in cell function.

Although this was thought to have been the disease of the past and that modern armies would not be subject to this injury, the British and the Argentine experience in the Falkland Islands clearly defined this as a possibility, as both suffered extensive trenchfoot injuries. Although cold urticaria, cold-induced paresthesia, Raynaud's, and cold-induced asthma have a relation to cold exposure, they are not usually considered to be cold injuries. Cold urticaria patients are subject to anaphylaxis and loss of function associated with plunging into cold water and are difficult to wean from cardiac by-pass. Cold-induced paresthesia are usually result of repeated mild cold injuries and are more of a nuisance than a serious medical threat. Raynaud's is an abnormal peripheral constriction associated with emotional stress, vibration, or cold. It is often a symptom of more serious life-threatening autoimmune disease but can exist as an idiopathic syndrome. Cold-induced asthma is bronchial constriction associated with breathing cold, dry air. Coronary artery constrictions may also occur from breathing cold air. This may elicit an episode of angina in compromised patients. The true non-freezing cold injuries, however, are chilblain, immersion foot and trenchfoot.

Chilblain - Chilblain results from a non-freezing cold exposure to the hands and feet, which usually produces swelling, arrhythmia, and some discomfort. Lesions generally occur between the joints, rather than over them. The chronic form of chilblain is termed pernio with superficial neurotic plaques about a half millimeter thick. It is caused by repeated exposures to above freezing temperatures, usually associated in high humidity. This injury is produced by repeated vasospasm and localized histamine release in the tissues which accounts for the subsequent compromise of blood flow. It appears swollen, red and quite tender and warm to touch. Itching is usually a common symptom. There is swelling, vasodilation, purple or red color and occasionally blisters will form with superficial ulcers. As it progresses, the itching is replaced by pain and tenderness. Chilblain is usually a self-limiting disease which has few long-term sequelae although the pain from the pernio injury can last a life-time, especially in children.

Immersion Foot - Immersion foot is long term cold water immersion, even in tropical water, which increases conductive heat loss. Immersion merely keeps the extremities cold and the vessels constricted. There are three stages: (1) Pre-hyperemic - may last hours or days. The tissue is cold, numb and swollen; (2) The hyperemic phase - up to three months long. There is tingling pain, swelling, blisters, which rupture producing ulcers, and gangrene. (3) Post-hyperemic phase - can last from weeks to years. It usually produces post-injury sequelae such as cold-induced Raynaud's, paresthesia, and severe pain upon cold exposure.

The general symptoms include numbness, tingling, itching, modest pain, leg cramps, the feeling of rubbing cotton on the feet. Life-raft injuries are immersion injuries, where individuals are exposed to long-term exposure in life-rafts.

Trenchfoot - Trenchfoot results from an exposure to a cold, wet environment, usually zero to 10 degrees C. Contributing factors are dependency of limbs, constrictive footwear, fear, fatigue and enemy action which restricts mobility. This is a circulatory and neurologic injury. Nerve and fat cells are particularly susceptible as is muscle.

Most of the damage is the result of ischemia and anoxia from vasoconstriction. As vessel walls become damaged, fluid leak out causing cellular plugs which make vasospastic ischemia permanent. The direct effect of cold on cell metabolism, membrane integrity and fluid dynamics plays a unspecified role in this injury.

The sequelae consists of hypohidrosis, pain, warm, dry, scaly skin and cold sensitivity. There are leg spasms, severe cold sensitivity, deep plantar aching, atrophy of tissue, particularly of muscle and fat. There is persistent pain which does not respond to pain medication. Osteoporosis may occur. Flexion contracture of the hands and feet along with claw deformities are common.

Most research effort in trenchfoot injury and treatment occurred after World War II and another flurry during the Korean War. Good histopathologic evaluation of the injury has been done on man and animal models. There is little interest in this injury in the civilian community and because Armies consider that prevention is more important than treatment, there has not been a sustained research effort. Prevention involves specific insulating footwear and enhanced training procedures for foot care which are more easily accomplished. If one were searching for new therapeutic modalities, free radical scavengers and non-steroidal anti-inflammatory drugs might be helpful. We have learned a great deal about re-perfusion injuries which might be useful in the early management of trenchfoot. New diagnostic procedures such as infrared thermography and Technicum scanning combined with older methods of nerve conduction and electromyography may define the severity of injury more precisely early in its course.

Treatment of trenchfoot has been palliative at best. Acute management utilizing anti-inflammatory, non-steroidal medications along with dextran intravenous therapy seems appropriate. Sympathetic blockade may be helpful but may increase edema and internal tissue pressures which lead to more ischemia. Free radical scavengers such as Allopurinol may improve cell survival. There is not a sharp line demarcation for tissue sloughing as there is in frostbite and moist liquefaction gangrene is common. Systemic infections with extremely high CPKs and DIC and fever are indications for surgical intervention. Sequential amputations may be necessary over a period of weeks because of the difference in tissue susceptibility and depth of injury in different parts of the limb. This is a much different course than freezing injuries which demarcate at a sharp 2 millimeter line, produce dry mummifying gangrene, seldom develop systemic infections, and do not require early surgical effort. The acute injuries are difficult to get out of the hospital. Pain, paresthesia, edema, poor healing, poor graft retention, and other sequelae combine to keep them bed ridden. Once out, they become a chronic medical burden because of symptoms, especially associated with cold, damp exposure, long-term standing, or ill-fitting shoes. Deep aching and pain on pressure are the most common complaints, although chronic ulceration also occurs. Argentine injuries have shown the same pattern of sequelae as injuries incurred in World War I. British injuries, although not as severe as the Argentine's required early release from military for many soldiers and marines. This injury will continue to be a sporadic problem in the civilian world, but Armies in certain battle scenarios will no doubt have to relearn the lessons of wars past about keeping the feet dry and changing socks.

## NON-FREEZING COLD INJURIES

1. Chilblain
2. Pernio
3. Trenchfoot or Immersion Foot
4. Raynaud's, Cold-induced Asthma, and Cold Urticaria

## PATHOGENESIS

1. Long-term cold exposure, usually above freezing.
2. Wetness increases conductive heat loss.
3. Long-term vasospasm.
4. Cell membrane damage from ischemia to nerves, muscles, and vessels.

## SYMPTOMS

1. Pre-hyperemic - hours to days - cold and numb.
2. Hyperemic - up to months, hot, painful, swollen, ulcers and gangrene.
3. Post-hyperemic - weeks to years - cold sensitivity, paresthesia, pain on cold exposure.

## TREATMENT PROBLEMS

1. Sympathetic blockade increases edema.
2. Liquefaction and infection requires surgery.
3. High CPK and DIC and fever requires surgery.
4. Pain medications not effective.



#### POTENTIAL FOR TREATMENT

1. Non-steroidals may help early.
2. Free radical scavengers - allopurinol.
3. Sympathetic blockade - reserpine.
4. Calcium channel-blockers.

#### SEQUELAE

1. Pain on cold exposure.
2. Paresthesia and cramping.
3. Muscle weakness.
4. Vasospasm on cold exposure.
5. Life-long disability.

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Wednesday, August 9, 1995

**HUMAN RIGHTS  
AND THE  
ENVIRONMENT**

*Aaron Sachs*

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## HUMAN RIGHTS AND THE ENVIRONMENT

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### OBJECTIVES:

Following this presentation, participants will....

1. Understand the social context of environmental crisis; recognize the importance of making ecology a human issue and asking the question, "Who pays the cost of environmental degradation?"
2. Know that while people in power and people living in the richer, industrialized countries instigate most environmental degradation, its costs are paid for mostly by the impoverished and the powerless.
3. Recognize how environmental protection would enhance social justice; and how protecting basic human rights would facilitate protection of the environment.

In recent years, the concept of "rights" in the environmental context has been co-opted by the "Wise Use" movement, especially in reference to an individual's property rights as a "counterbalance" to environmentalists' demands that certain pieces of land be left undeveloped. The environmental movement needs to take back the rights framework, by emphasizing the human context of environmental degradation. Every social contract ties rights to responsibilities. Should personal property rights be held so sacrosanct if certain activities conducted on private land end up harming the people living in adjacent areas? There is in fact an international moral consensus--as written into numerous United Nations documents--that every citizen has the right to the basic elements of survival--which include a healthy and healthful environment.

South Africa's apartheid system represented a perfect example of how human environmental rights are enjoyed unequally--and typically violated by powerful governments or corporations. Blacks were forced by the white supremacist government onto "homelands" that did not have adequate trees for fuelwood or adequate water and soil for food production. In addition, black land reserves and townships have borne the brunt of the devastating pollution caused by South Africa's huge mining industry. The Mngweni River, which flows directly into a densely populated valley in the KwaZulu homeland, contains mercury concentrated at 1500 times the level officially allowable in the United States.

Obviously, a better environment would have facilitated the enjoyment of South African blacks' basic right to a healthy life. And such devastating environmental degradation could perhaps have been avoided if they had enjoyed certain civil rights--if they had gotten the opportunity to find out about the mercury and cyanide and arsenic flowing into their water supplies, and to organize protests, and to vote.

In the United States, "community right to know" legislation has now guaranteed citizens access to scientific documentation of any harmful impacts of industry or government activities. Thanks to such measures--which could be implemented in other countries--communities now have the power to challenge "official" assessments of environmental health and safety conditions. Closely related measures, designed to give more power to affected communities, could create official structures whereby citizens, resource users, scientists, industry, and government would all sit at the same decision-making table. One key to minimizing abuses of human environmental rights is closing the gap between the decision-making process (we bureaucrats and businessmen want to dump this hazardous waste in this community, even though the water table is higher than the legal limit) and the actual experience of the consequences of those decisions (we citizens have higher than average cancer rates).

As with my presentation on environmental refugees, my attached article on child prostitution can serve as a case study to illustrate these general points. Child prostitutes by definition suffer human rights abuses. But what is important to note is that many of them end up in the hands of sex traffickers specifically because their families were forced to flee degraded environments, which they had not been able to protect for lack of certain civil rights.

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THE

COMMODITY:

# Child Prostitution in the Developing World

Once considered a universal crime,  
the trade in children's bodies is increasingly  
regarded simply as a business—with plenty of  
support from tour agencies, affluent travelers,  
and even governments.

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B Y A A R O N S A C H S

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*"At 10 you are a woman.  
At 20 you are an old woman.  
And at 30 you are dead."*

—Saying in Bangkok's red-light district

◆  
During the spring of 1992, government officials in Rio de Janeiro made a concerted effort to clean up their city. As hosts of the upcoming Earth Summit, known officially as the United Nations Conference on Environment and Development (UNCED), the Brazilians were intent on displaying Rio's best side. Besides picking up garbage and beautifying the local waterways, public officers also tried their best to wipe clean the most obvious signs of the port city's thriving sex industry—as is the custom before most large-scale international gatherings. But everyone knew that arresting a few hundred prostitutes would hardly erase Rio's racy reputation. What Brazil really did not want the world to see was that the city's red-light districts had recently begun to overflow with young girls and boys.

Some girls are  
bought by  
wealthy ranchers  
who gang-rape  
them to death  
on Saturday  
nights.

Children are the most powerless members of the human community. Those who end up in the sex industry, a majority of whom are girls from remote villages, are perhaps the most unlucky. As poverty pushes rural families toward ruin, children often find themselves growing up in a hurry, on their way to the urban underworld, whether they left independently in search of some sort of opportunity, or were stolen or sold into slavery, or were simply

turned out of their homes. In Northern Thailand and Northeast Brazil and many other impoverished regions of the developing world, entire villages are bereft of teenagers. Some have ended up in the brothels of Bangkok and Ranong, locked in tiny cement cubicles, serv-

ing 10 to 15 disease-ridden clients every day. Some have ended up in Rio, bought by wealthy ranchers who gang rape them to death in a regular Saturday night ritual.

Child prostitution is not new. But sex has become a multibillion-dollar industry, and today children are being bought, sold, and traded like any other mass-produced good. In the ever-expanding free market, child prostitutes are among the hottest commodities. Brazil alone has between 250,000 and 500,000 children involved in the sex trade, and a recent study conducted by the Bogota Chamber of Commerce concluded that the number of child prostitutes in the Colombian capital had nearly trebled over the past three years. Similar increases have occurred in countries as geographically and culturally disparate as Russia and Benin. But the center of the child sex industry is in Asia: children's advocacy groups assert that there are about 60,000 child prostitutes in the Philippines, about 400,000 in India, and about 800,000 in Thailand. Most of the children are under 16, and most are girls, though there are a few parts of the world where the local child sex industry caters to pedophiles seeking young males. Almost all of Sri Lanka's 20,000 to

30,000 child prostitutes, for instance, are boys.

As troubling as it may sound, the explosion of the child sex trade comes down to two basic market forces: supply and demand. A global society destabilized by the HIV/AIDS pandemic, environmental stress, and the rapidly widening gap between rich and poor, is producing both more potential victims and more potential exploiters of the sex industry. And the criminal sex traffickers, just like any other opportunistic middlemen, have stepped in to take advantage of the situation—while society has simply looked the other way.

Massive efforts to cover up child prostitution, as in Rio, merely delay our inevitable confrontation with its root causes. In the 1990s, the child sex industry is no longer just a shameful reminder of the criminal element lurking beneath the surface of every civilization. The recent boom in child prostitution points to a fundamental injustice in the current materialist world order—a global willingness to sacrifice society's most vulnerable members for the sake of others' economic and sexual gratification. We are quite literally mortgaging our future.

No story is more wrenching than that of a child prostitute who has been deceived or forced by violence into her trade. But it is perhaps even more tragic, and more significant for society, when parents who have no other criminal dealings knowingly offer up their children to sex traffickers. Such decisions signal a raw desperation in the countryside. Without extra land, without faith in potential economic opportunities, especially for girls, parents see no point in training their children, either at home or at school. Hope dies before their babies even learn to walk. Many parents can hardly feed themselves, and find it nearly impossible to refuse a cash payment in exchange for one of their daughters, whom they often expect to come back a few years later in full health and with substantial savings. In Thailand, even poor, uneducated villagers often realize that a woman in the sex industry, as a study sponsored by the International Labor Organization has shown, can make about 25 times as much as she could in any other occupation open to her.

The causes of rural poverty, the forces behind this desperation, are even more distressing. In the region formerly known as The Golden Triangle, for instance, along the borders of Thailand, Burma, Laos, and China, many of the villagers, like the peoples of the Amazon rainforest, used to derive their income from forest products—charcoal, bamboo

shoots, wild mushrooms, squirrels, even edible toads. Small-scale subsistence farmers also depended on the forests to provide breaks against soil erosion and to regulate natural irrigation systems. But logging projects, whether legal or illegal, and whether initiated by national governments, multilateral development banks, timber companies, or frontier squatters, have laid waste to the area's hillsides over the last three decades. Economists often point to Thailand as a clear success—and the country's lucrative exports, consisting mostly of agricultural products grown on previously forested land, have certainly helped boost the Thai economy. Export-oriented economic development, however, despite its popularity at such institutions as the World Bank and the International Monetary Fund, often has a price, and Thailand is still paying it. Because the Thai government was investing so heavily in logging and large-scale export agriculture, it had to cut back its social spending, so the poorest people in the Golden Triangle region lost not only their livelihoods but also the government's support services.

By now, a few wealthy proprietors have bought up all the viable agricultural land in the Golden Triangle, and many of the villagers have become opium-addicted landless peasants. They are generally able to scrape by as agricultural laborers or tenant farmers in the growing season, but they no longer have alternative sources of income during the rest of the year. With little help forthcoming from national governments, peasant families often have to turn to the private sector—or, in the case of sex traders, the private sector swoops down on them. Even when parents manage to stave off the pimps and traffickers in the provinces, they sometimes find they can

do nothing for their children except suggest that they seek their fortune in the city, where more pimps and traffickers await. These days, according to United Nations estimates, girls aged 10 to 14 have the developing world's highest rates of rural-urban migration.

While these socio-economic conditions have served to expand the potential supply of child prostitutes by a vast margin, the demand for them has perhaps increased even more. And it is the demand for child prostitutes that turns vulnerable children into victims.

A mythicization of virginity has fueled the demand for underage sex partners for centuries, but in the era of HIV/AIDS that mythicization has intensified dramatically. Customers at brothels have been asking for younger and younger girls, believing that they are more likely to be free of disease. If the girls come from particularly remote rural areas, so much the better.

HIV/AIDS is passed mostly heterosexually in the developing world, and it is already crippling entire communities there, because its victims are generally in their most productive years and because most developing countries have very little funding for health services. Sadly, the involvement of children in prostitution is merely facilitating the spread of HIV/AIDS—and is rapidly killing the children. Younger people are actually more likely to contract HIV during intercourse, because their tissues are more easily torn. According to Saphasit Koompraphant, director of the Children's Rights Protection Center in Thailand, the HIV infection rate among Thai child prostitutes is now approaching 50 percent. And when pimps and brothel-owners discover that one of their girls has the deadly virus—often by testing her without her knowledge—they usually send her straight back to her home village. Once there, she will likely be cut off from medical care, and, because such communities have little experience with HIV, the virus may end up spreading even further. Child prostitution is one of the most important forces driving HIV/AIDS from its urban epicenters out to rural areas, which are still home to about 65 percent of the developing world's population.

Three years ago, the Japanese Foundation for AIDS Prevention, an organization affiliated with the Japanese government, launched a high-profile poster campaign. Their central image was of a middle-aged man wearing a business suit, grinning, and displaying his passport. The caption read: "Have a nice trip! But be careful of AIDS." The assumptions



implicit in this poster point to the other major factor behind the recent increase in the demand for child prostitutes: sex tourism. When challenged, the Foundation justified its campaign as a reality check, citing the statistic that 60 percent of the Japanese men who contracted HIV through heterosexual sex did so overseas. But the language of their caption, in the name of AIDS prevention, could be interpreted as endorsing exploitative sexual behavior and giving sanction to those businesses and travel agencies that arrange sex tours in poorer countries like Thailand, the Philippines, and Sri Lanka. One could even read the poster campaign as endorsing child prostitution, since seeking out younger prostitutes is seen by many men as a way of "being careful of AIDS."

Asia is at the center of child prostitution because of sex tourism. In 1967, when the U.S. government, entrenched in the Vietnam War, signed a treaty with Thailand enabling U.S. soldiers to come ashore for "R&R" (Rest and Relaxation), and giving the sex tourism industry what amounted to official sanction, a new era dawned. Less than a decade later, Thailand could claim more than 20,000 brothels and other sex-industry establishments; and the hyped mythology of the young, submissive, sexy girls waiting for wealthy tourists in sultry Southeast Asia was making its way around the world.

Of course, child prostitution in Asia is not completely governed by the politics and economics of sex tourism—it is also deeply embedded in many local and national cultures. In Thailand, for instance, according to Harvard researcher Hnin Hnin Pyne, 75 percent of all men have had sex with a prostitute. And in the southwestern Indian states of Maharashtra and Karnataka, believers in the Hinduist Devadasi system, who today number in the hundreds of thousands, have been dedicating their daughters to a religiously sanctioned life of prostitution for well over a millennium.

The explosive overlap of growth in the tourism and sex industries, though, is certainly one of the main forces behind the recent child prostitution boom in Asia. In 1980, only 1.8 million tourists visited Thailand, but by 1988 that number had jumped to 4.3 million—of whom, according to Steven Schlosstein, author of *Asia's New Little Dragons*, about three-quarters were unaccompanied men. And as more sex tourists arrive, opportunistic sex traffickers cast their nets even wider, snatching up ever-younger girls. Meanwhile, travel agencies in richer countries, also seeking to cash in, are

doing their own recruiting. Kanita Karmha, a Dutch tour company, recently circulated a brochure that described prostitutes in Thailand as "little slaves who give real Thai warmth." Two years ago in August, the Austrian airline Lauda Air ran a mock postcard in its in-flight magazine that featured a picture of a young, shirtless girl with a caption saying "From Thailand with Love." The back of the postcard explained that the writers didn't have time to say much because "the tarts in the Bangkok Baby Club are waiting for us." Rich tourists, according to Ellis Shenk, the director of the New York branch of the international Campaign to End Child Prostitution in Asian Tourism (ECPAT), "have realized that human life is cheaper in the Third World." First-World pedophiles are willing to do things in poorer countries that they would never do in Japan, or Austria, or the United States.

The First World even went so far as to encourage countries like Thailand to develop their sex tourism industries—if not explicitly, then in a highly suggestive manner. In 1971, Robert McNamara, the president of the World Bank (see cover story), without specifically mentioning the sex industry, urged Thailand to supplement its export activities with an all-out effort to attract rich foreigners to the country's various tourist facilities. After all, spending by U.S. military personnel on R&R in Thailand had quadrupled between 1967 and 1970, from about \$5 billion to about \$20 billion. McNamara was probably well aware of that trend, because he just happened to have been Secretary of Defense under President Lyndon B. Johnson at the time of the infamous R&R treaty. And he would have had to be unimaginably naive not to know that R&R usually meant sex.

By 1975, Thailand, with the help of World Bank economists, had instituted a National Plan of Tourist Development, which specifically underwrote the sex industry. The new plan basically just buttressed the 1966 Entertainment Places Act, the national law that had made possible the international R&R treaty. Without directly subsidizing prostitution, the Entertainment Places Act, referring repeatedly to the "personal services" sector, gave encouragement to pimps and brothel-owners by suggesting creative ways in which to develop their industry. In the words of Thai feminist Sukyana Hantrakul, the law "was enacted to pave the way for whorehouses to be legalized in the guise of massage parlors, bars, nightclubs, tea hous-

es, etc.” The Act also made it clear that the proprietors of entertainment establishments could feel free to hire whomever they wanted: the maximum fine for employing a “hostess” or “masseuse” under the age of 18 was 2000 baht—or about \$100.

The seemingly official sanction on child prostitution, of course, makes it an even more attractive profession to all the criminal sex traffickers, the middlemen who bring supply and demand together. Often traffickers have to go to great lengths to procure victims, even crossing national borders. Agents from Bangkok and Bombay go deep into Burma and Nepal looking for the most unsuspecting families, whose daughters have never been out of their villages and don’t speak the language of the cities to which they will be brought. Usually traffickers tell the families that their girls will become domestic servants for rich families, or waitresses at posh restaurants. The money exchanged is generally considered a loan, which the child must repay through her work. Bringing the girls back to urban havens of prostitution often involves bribery and politicking in two countries, and yet the system rarely fails: sex-industry criminals simply do not get arrested. Last year, the regional army commander in Ranong, Thailand, made a public statement welcoming the trafficking of illegal aliens into his community, explaining that Ranong “needed the cheap labor to sustain its growth.”

Examples of blatant complicity on the part of government officials are all too common. In 1989, 3,000 young girls became part of the Devadasi prostitution system at a massive festival in southern India; the local police force directed traffic. In both Brazil and Thailand, police officers are often prime customers of child prostitutes, threatening the children with arrest if they do not perform certain services. Sixty percent of the Sao Paulo street children interviewed in a recent three-year study reported that the local police had engaged them in sex acts. Bangkok is notorious for its clusters of brothels around almost every police station, and child prostitutes in the Thai capital often say that it is fear of the police, even more than fear of their pimps, that prevents them from trying to run away. To this day, according to Human Rights Watch, “despite clear evidence of direct official involvement in every stage of the trafficking process, not a single Thai officer . . . has been investigated or prosecuted.”

Whenever government officials crack down on

child prostitution, it is almost always the children who suffer, who get arrested and perhaps deported. Somehow, powerless, uneducated children become solely responsible for the sex industry. In late 1992, Thai Prime Minister Chuan Leekpai announced a new campaign to stop child prostitution for good, at the crux of which was an exhortation to his countrymen to do a better job of “instilling self-respect” in their daughters. One Thai police chief, when asked why officers never arrested the customers of child prostitutes, explained: “That would violate their human rights.”

Ultimately, child prostitution exists because men have used their positions of power to elevate the status of their sexual gratification, to make the debasement of young girls socially acceptable. Underlying all of the social and economic forces driving child prostitution, then, are obscene cycles of gender bias. One Indian girl, forced into marriage at an early age, first failed to get pregnant and was turned out of her house by her husband, then was rejected by her parents, and finally sought help from another close relative, who promised to find her a good job and promptly sold her to a brothel.

Most young girls who end up as prostitutes experience a world that alternately uses and rejects them. Passed from parents to cold and often abusive traffickers, to intimidating brothel owners and police officers, and finally to frustrated and power-hungry customers, many child prostitutes are not empowered enough even to feel wronged by society. Their predominant feelings are fear of being abused yet again by the next stranger who comes into their life, and shame at being a financial burden and at being involved in a “dirty” profession. Yet the men who control their worlds have convinced them that they aren’t good enough to make any other contribution to society. Most relief workers say that the full rehabilitation of child prostitutes is virtually impossible.

Girls aged  
10 to 14 have  
the developing  
world’s highest  
rates of rural-to-  
urban migration

— If too often, official attempts at rehabilitating child prostitutes consist of one-year sentences at prison-like reform schools. In accordance with the Thai Prime Minister's pronouncement on girls' lack of self-respect, it is the victims who continue to get the blame. As long as child prostitution is presumed to be caused by nothing more than the children's own promiscuity, men in power never have to take responsibility for the socio-economic systems that underwrite discrimination against women, poverty, environmental degradation, and criminal exploitation.

Society owes its children a genuine, global proclamation that child prostitution is simply no longer acceptable. Of course, such a proclamation would mean that government officials could no longer institute the types of development programs—from all-out logging for the sake of export agriculture to the indirect subsidizing of the sex tourist industry—that make certain people expendable. Instead, both governments and multilateral lending organizations would have to come up with smaller-scale projects more appropriate to existing natural resources and local livelihoods. Most importantly, though, to end child prostitution, national governments will have to develop the political will to eradicate the corruption in their own ranks, to crack down on the people who in turn are supposed to be cracking down on the child sex trade.

In the past two years, as child prostitution has become more visible, there has been at least a little progress. On the international level, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) has joined up with the recently formed Coalition Against Trafficking in Women to draft a new Convention on the Elimination of All Forms of Sexual Exploitation. In Thailand, the Prime Minister's Office, with support from the United Nations Children's Fund (UNICEF), has set up both a Center to Prevent and Suppress Child Prostitution and Labor Abuses and a hotline for the anonymous reporting of child prostitution cases. And a few of the world's richer countries, including Germany and the United States, have begun to address sex tourism by initiating laws that will punish citizens for committing sex acts with minors on foreign soil.

The organizers of overseas sex tours, however, have already proven their ability to circumvent laws. And their operations, in particular, reveal the extent to which child prostitution has embedded itself in world culture. Right now, the phenomenon of sex tourism involving child prostitutes seems almost to be a natural outgrowth of the global economy—which, after all, is driven by the consumptive lust of

the wealthiest countries, and which offers huge incentives to exploit the natural resources on which everyone's future depends. At the Earth Summit in Rio, delegates discussed at length the inequity of a global economy that permitted First World colonial empires to engage in institutionalized rape—of the Third World's lush forests, its mineral-rich mountains, and its fragile wetlands. But nobody mentioned the Third World's children. ♦

Aaron Sachs is a staff researcher at the Worldwatch Institute. His article "Men, Sex, and Parenthood in an Overpopulating World" appeared in the March/April issue.

Human Rights Watch, *A Modern Form of Slavery: Trafficking of Burmese Women and Girls into Brothels in Thailand* (New York, 1993).

Ron O'Grady, *The Child and the Tourist: The Story Behind the Escalation of Child Prostitution in Asia* (Bangkok, 1992).

Thanh-Dam Truong, *Sex, Money, and Morality: Prostitution and Tourism in Southeast Asia* (London, 1990).

## FOR MORE INFORMATION

### End Child Prostitution in Asian Tourism (ECPAT)

ECPAT Information Centre  
328 Phayatai Rd.  
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New York, NY 10115  
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### Defence for Children International

Case Postale 88  
CH-1211 Geneva 20  
Switzerland

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Thursday, August 10, 1995

# INTRODUCTION TO ISMM

*Jean-Paul Richalet, MD*

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*Material on the ISMM will be available at the presentation.*

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Thursday, August 10, 1995

# CEREBRAL ETIOLOGY OF AMS

*Peter Hackett, MD*

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## **The Cerebral Etiology of Acute Mountain Sickness and High Altitude Cerebral Edema**

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### **Learning objectives:**

Following this presentation, participants will be able to:

- 1) discuss the new concepts of pathophysiology of acute mountain sickness and high altitude cerebral edema, and
- 2) understand the rationale for treatment of AMS and HACE based on the pathophysiology.

# The Cerebral Etiology of Acute Mountain Sickness and High Altitude Cerebral Edema

## I. The stress: hypoxia

## II. Cerebral oxygenation and cerebral blood flow

### A. Cerebral oxygen delivery

1. brain O<sub>2</sub> delivery = arterial O<sub>2</sub> content X cerebral blood flow (cbf)
2. increased ventilation attempts to maintain SaO<sub>2</sub>, but hypocapnia reduces cerebral blood flow (cbf)
3. hypoxia overrides vasoconstriction and causes net vasodilatation when PaO<sub>2</sub> generally < 55 to 60 mm hg, SaO<sub>2</sub> < 90%
4. plasma diuresis increases [Hb], so arterial O<sub>2</sub> content maintains
5. increased [Hb] and cbf may actually increase cerebral O<sub>2</sub> delivery at moderate altitude
6. BUT - driving force for diffusion of O<sub>2</sub> to tissues is the PaO<sub>2</sub>, not the arterial oxygen content. PaO<sub>2</sub> may be low enough for inadequate diffusion to tissues, especially in watershed areas of cerebral circulation, and in tissues with highest O<sub>2</sub> dependency
7. regional differences in cbf may be substantial, ex: brainstem > cortex
8. value of increased cbf limited by contributing to edema

### B. Cerebral tissue/cellular utilization

1. cerebral metabolic rate for O<sub>2</sub> is maintained, even increased transiently, without lactate production until extreme hypoxia
2. cerebral energetics (ATP production) is maintained until extremely low PaO<sub>2</sub>, on the order of < 15 mm Hg
3. nevertheless, cerebral dysfunction occurs - cells or parts of cells affected by moderate hypoxia

## III. Neurotransmitters

Data on neurotransmitters and clinical hypoxia are surprisingly few, in contrast to the volumes of research on ischemia. All may be affected to some degree, since their synthesis pathways involve very oxygen-sensitive enzymes. Degradation of NT's and receptor regulation are other factors besides synthesis. Though NT changes may explain cerebral dysfunction at high altitude, they have not been implicated in altitude illness.

### A. Acetylcholine

- diminished with hypoxia, thought to produce the lassitude

### B. Serotonin

- tryptophan hydroxylase very sensitive to hypoxia, reduces 5ht

- clinical effect not well established, may affect cognition
- C. Dopamine
- D. Norepinephrine
  - synthesis of both may be impaired
- E. Adenosine, glutamine, and other amines
  - thought to play important roles in ischemia, doubtful in hypoxia

#### IV. Intracranial dynamics

##### A. Intracranial volume

1. the brain appears to swell at altitude
  - *recent data, though limited, suggest brain tissue enlarges*
2. CSF accommodation
  - *CSF is displaced into the spinal canal*
  - *CSF absorption increases*
  - *CSF production decreases?*
  - *the more extracerebral CSF in the cranial vault, the more accommodation can take place - i.e., the less brain in relation to the cranial vault, the better for maintaining normal volume*
  - *the more room for CSF in the spinal canal, the better*
  - *factors affecting the two above include individual variation, age, certain diseases*
  - *CSF accommodation takes time - the faster the rate of ascent, the less complete the equilibration*
3. Cerebral blood flow
  - *in the setting of increased brain volume, increased cbf is detrimental*
  - *cbf does not decrease in response to early brain swelling*

##### C. Intracranial pressure

1. Pressure-volume relationship
  - *as volume increases, pressure does not change much until a critical value is reached, beyond which pressure rises dramatically*
  - *pressure change greater with edematous poorly compliant brain than with a soft compliant one*
2. ICP and CSF pressure measurements in altitude illness
  - *patients with advanced AMS or HACE clearly have  $\uparrow$ CSFP*
  - *animal model with moderate AMS somewhat increased ICP*
  - *human subjects with mild AMS little increase, but brain volume increased*
  - *tentative conclusion is that elevated ICP per se may not cause AMS, but that AMS is associated with brain swelling*

#### V. Mechanism of brain swelling

##### A. Evidence for a vasogenic edema (blood brain barrier leak)

1. MRI's of patients with HACE show dramatic reversible edema of white matter tracts only, and no cortical or gray matter edema; this is pathognomonic for vasogenic edema

2. AMS responds very well to steroids, which are effective only in vasogenic brain edema

3. animal studies show extravasation of Evan's blue dye

4. time course of onset and recovery

5. markers of endothelial permeability parallel course of illness

**B. Pathophysiology of vasogenic edema (not well understood)**

1. possible mediators:

*eicosanoids*

*oxygen, hydroxyl radicals*

*bradykinin and other kinins*

*nitric oxide (suppressed by dexamethasone)*

2. possible role of angiogenesis

*in response to hypoxia, macrophages produce growth factors which stimulate endothelial cell mitosis in preparation for making new capillaries*

*in the process, capillary permeability increases*

*mediators include tumor growth factor- $\beta$ , vascular endothelial growth factor, vascular permeability factor, tumor angiogenesis factor, interleukin 2 and 8, and others*

3. central noradrenergic mechanism

*in monkey experiments, stimulation of locus coeruleus*

*promptly increased brain capillary permeability*

**VI. Therapy based on pathophysiology**

**A. Decrease brain swelling**

1. role for oxygen and descent (or hyperbaria), osmotic diuretics, questionably furosemide

2. definite role for steroids, most effective when given early

3. problems with hyperventilation therapy because these patients are already alkalotic, and also, reducing cbf may render the brain ischemic - remember that oxygen is a potent cerebral vasoconstrictor in this setting, and probably sufficiently reduces cbf

4. acetazolamide may be given early, to speed acclimatization

*- one of its actions is to reduce CSF formation, but it also stimulates ventilation, thereby decreasing the hypoxic stress*

*- in usual oral doses, it does not increase cbf, as it does dramatically when given in large i.v. doses*

**B. Stop the BBB leak**

1. oxygen and/or descent

2. steroids - may act by decreasing nitric oxide

3. ? prostaglandin inhibitors - ibuprofen and aspirin shown to help AMS, naproxen did not

4. possible role for agents against angiogenesis, lipid peroxidase inhibitors, lazaroids, NO inhibitors, and many more

**C. Prevention**

1. slow ascent gives CSF time to displace increased brain volume, maintains compliance
2. induced diuresis helps prevent brain swelling
3. acetazolamide improves oxygenation, reduces CSF, promotes diuresis
4. steroids effective when necessary

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Thursday, August 10, 1995

**HEART DISEASE  
AND HIGH ALTITUDE**

*Herbert N. Hultgren, MD*

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REVIEW:  
EFFECTS OF ALTITUDE UPON CARDIOVASCULAR DISEASES.

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Objectives of Lecture.

Following this presentation participants should be able to:

1. Properly evaluate patients with coronary disease and hypertension who plan to visit high altitude.
2. On the basis of the evaluation make proper recommendations as to who can go to high altitude, describe the possible symptoms that may be experienced as well as the appropriate methods of preventing or treating such symptoms.

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### ABSTRACT

Physicians should be aware of sea level cardiovascular problems that may be aggravated by exposure to high altitude. Increasing numbers of middle-aged and elderly individuals are visiting high altitude areas to ski, trek or attend conferences. Many Elder Hostel programs are held in mountain environments. A recent survey of 1909 adult visitors of Keystone, Colorado [altitude 9,300 ft (2837 m)] revealed that 48% were 40-60 years of age and 15% were over 60. Sixty-six percent were males.<sup>1</sup> Approximately 20% of trekkers in Nepal were 50 years of age or older.<sup>2</sup> The prevalence of many cardiac conditions rises rapidly after age 50. For example, the mean age of entry of 2,234 men into three large randomized studies of surgery in coronary artery disease were 50-51.<sup>3</sup>

This presentation will reviews altitude-induced changes that affect the circulatory system and examine two cardiovascular conditions that are adversely affected by altitude. These are coronary artery disease and systemic hypertension. High altitude, for the purpose of this presentation, is defined as elevation above 8,000 ft (2440 m), since altitude illness and altitude aggravation of sea level conditions are rare below this altitude.

**KEY WORDS:** altitude, cardiovascular disease, coronary heart disease, angina pectoris, hypertension, pulmonary hypertension.



### **Effect of high altitude upon the circulation**

Several important circulatory changes occur during exposure to high altitude.<sup>4,5</sup> These include:

1. Increase in resting and exercise heart rate.
2. Increase in cardiac output and velocity of cardiac contraction.
3. Increase in systemic vascular resistance and systemic blood pressure.
4. Contraction in veins in the skin, muscles, and viscera with an increase in central blood volume.

The sum effect of these changes is an increase in cardiac work, cardiac oxygen consumption, and coronary blood flow. These changes are largely due to an increase in sympathetic activity mediated by the effect of hypoxia upon the chemoreceptors in the carotid bodies.<sup>5,6</sup> Epinephrine secretion is transiently increased and norepinephrine secretion is increased for several days.<sup>7</sup>

Pulmonary ventilation is increased in proportion to the altitude, resulting in a respiratory alkalosis which is partially corrected after several days. A prompt decrease in plasma volume occurs with ascent, resulting in a 10 to 20% decrease in total blood volume, with a resulting rise in hemoglobin and hematocrit.<sup>4</sup> After 2 to 3 weeks, increased red cell production restores the total blood volume to normal pre-ascent values.<sup>8</sup> Maximal physical working capacity, as measured by maximal oxygen consumption, is decreased.<sup>9</sup> The decrease is proportional to the altitude and amounts to a decrease of approximately 3% for every thousand feet of altitude above 5,000 ft (1500 m).

A modest increase in pulmonary vascular (pre-capillary) resistance occurs, with a resulting increase in pulmonary artery pressure. In some patients with an elevated pulmonary artery pressure at sea level, a marked rise in pulmonary artery pressure may occur.

After 4-8 days at high altitude, most circulatory changes subside; during a longer period of altitude exposure, several values will fall to levels below those seen at sea level. For example, resting and exercise cardiac output are decreased.<sup>10</sup> Left ventricular and atrial chamber size decrease without changes in cardiac function.<sup>11,12</sup> Systemic blood pressure decreases and after a prolonged stay at altitude, blood pressure may fall to below sea level values.<sup>13,14</sup> These effects are due to a decrease in sympathetic nervous system activity, probably in part due to a decrease in peripheral receptors.<sup>15</sup> Pulmonary artery pressure remains elevated.

### **Coronary artery disease**

The increase in cardiac work associated with ascent to high altitude may result in increased severity of angina, the new onset of angina, or unstable angina.

An example of angina made worse by exposure to high altitude is represented by the following case report: a 70-year-old businessman had angina pectoris since suffering a myocardial infarct 22 years previously. His angina had progressed slowly, so that he experienced chest pain with minimal physical effort. By limiting his activity, he was able to carry on a sedentary existence, with only 1-2 episodes of chest pain a day. He occasionally had nocturnal angina. His medications included nitroglycerine prn, aspirin 325 mg per day, propranolol 40 mg t.i.d. and diltiazem 60 mg t.i.d. He never had hypertension. Frequent treadmill tests were stopped after 1-2 min because of chest pain. He had not had coronary arteriography or coronary bypass surgery. Recently, he and his wife traveled to Denver, Colorado, where they spent the night. No increase in symptoms was noted. The following day they drove to Vail, Colorado [altitude 8,200 ft (2500 m)]. Upon crossing Loveland Pass [altitude 11,900 feet (3630 m)] the patient began to experience frequent episodes of angina and dyspnea, relieved by nitroglycerine. His wife noted he was quite blue and clearly in distress. Upon arrival at Vail, his anginal attacks continued, but he was able to sleep

moderately well. The following day repeated episodes of chest pain and dyspnea caused them to return to Denver. Once over Loveland Pass the patient felt much better and upon return to sea level, his original attacks returned to the pre-ascent frequency.

#### Comment

With such severe angina and limitation of effort at sea level, the patient should not have gone to Vail. When his angina became worse at Vail, a physician should have been called. It is very possible that low flow oxygen might have substantially relieved his symptoms. It is of interest that he did not experience an increase in symptoms at Denver [altitude 5,400 ft (1647 m)].

An analysis of 21 coronary events occurring within five days of arrival at Keystone, Colorado has recently been completed by this author. Seventeen patients had severe angina, two experienced an acute infarction, and two weee sudden deaths. Fifteen patients were males. The mean age of all patients was 58 years (range 40-74). Elevated blood pressure and heart rate were present in most cases. Symptoms subsided with bedrest, medical therapy, oxygen, and descent. One patient developed severe angina upon arrival at Keystone. The pain subsided on descent to a lower altitude and became severe upon return to Keystone five days later. The electrocardiogram during chest pain revealed T wave inversion in the precordial leads. After medical treatment, a normal, a normal coronary arteriogram was obtained and a diagnosis of altitude-induced coronary spasm made. Coronary spasm can be produced by sympathetic stimulation and alkalosis, both of which occur at high altitude.<sup>16</sup>

The most likely mechanism of altitude-aggravated angina is an increase in cardiac work, primarily due to the increase in systolic blood pressure and heart rate. Morgan and associates studied nine men with angina by graded treadmill testing at 5,248 ft (1600 m) and upon arrival at 10,150 ft (3100 m). Mean maximal oxygen

uptake was reduced by 11%. Angina and/or ST segment depression occurred at the same heart rate/systolic pressure product, but a lower work loads and a shorter duration of treadmill time.<sup>17</sup> The effect of hypoxia was via the increase in cardiac work and not oxygen lack to the myocardium. If oxygen delivery to the myocardium had been reduced, angina would have occurred at a lower double product than that at the lower altitude.

The prevalence of coronary disease among the skiing population at Keystone is unknown. An estimate can be made from telemetry electrocardiograms obtained by Grover in 149 men during recreational skiing at altitudes above 10,150 ft (3100 m). Tachycardia was significant and heart rates exceeded 80% of the predicted maximum in two thirds of the subjects. Five men developed abnormal ST segment depression during or immediately after exercise. All five were older than 40 years. Thus, the incidence of ST abnormalities in this skiing population was 5.6%. This is similar to the incidence in asymptomatic men during submaximal exercise at low altitude. Grover concluded that mountain skiing does not appear to pose a greater coronary stress than does comparable exercise at low altitude in men without known heart disease. Only one of his subjects had coronary disease.<sup>18</sup> The risks of trekking in patients with coronary disease has been reviewed by the author.<sup>19</sup>

In summary, ascent to 9,300 ft (2837 m) may precipitate coronary events within a few days of arrival. Accelerated angina or new onset angina are the most common presentations, but acute infarction or sudden death may occur. Systemic hypertension and a rapid heart rate are commonly present and may be causative factors. Acute coronary spasm may occur. Many patients had experienced chest pain or infarction prior to ascent. Physicians should caution such patients that symptoms may appear or become worse with rapid ascent to high altitude. The use of anti-anginal or anti-hypertensive medications should be employed in appropriate patients. Acclimatization for 2-3 days at an intermediate altitude [6,000-7,000 ft (1830-2135 m)]

may be helpful, and has been shown to decrease the incidence of acute mountain sickness. Restricted activity for a few days after arrival may minimize symptoms. Bed rest, low flow oxygen, or descent may be necessary if symptoms are severe. Asymptomatic patients without known heart disease may ski at altitude without a great prevalence of myocardial ischemia than would be present while performing a similar level of moderate to heavy exercise at lower elevation.

Patients with coronary disease who are asymptomatic on normal activity at sea level will usually tolerate moderate altitude without difficulty. This was examined in 97 subjects who travelled to Vail, Colorado (8,200 ft) for a reunion. The mean age was  $70 \pm 4$  years. Twenty-one percent had some evidence of coronary disease. Sixty-one percent of electrocardiograms were abnormal. However, during the altitude stay no electrocardiographic changes occurred that were indicative of myocardial ischemia and no subjects exhibited any change in symptoms despite normal or even moderate bouts of exertion.<sup>20</sup>

### **Systemic hypertension**

#### Normal subjects

Normal subjects usually exhibit a modest rise in blood pressure during the first week or two after ascent to high altitude. Several studies have indicated an elevation of both systolic and diastolic pressures, as well as an increase in heart rate, during high altitude exposure. Systemic vascular resistance is increased.<sup>4</sup> Kamat observed a rise in blood pressure in 31 of 32 subjects who ascended to an altitude between 11,500 ft (3506 m) and 13,000 ft (3906 m).<sup>21</sup> Systolic pressure rose from 115 mmHg to 125 mmHg and diastolic pressure rose from 78 mmHg to 93 mmHg.

Wolfel and his associates reported significant elevations in blood pressure and peripheral vascular resistance in seven young men exposed to 14,000 ft for 21 days. Mean blood pressure rose from 124/71 mmHg to 145/88 mmHg and estimated

systemic vascular resistnace rose from 17 to 28 Wood units (mmHg/L/min) mean values. Pressures during exercise were higher than at sea level. Arterial norepinephrine levels were increased.<sup>8,22</sup>

### Hypertensive patients

Patients with hypertension at sea level may experience a further rise in blood pressure with ascent to high altitude. In some individuals, a marked rise in pressure may occur. This is illustrated by the following case report: a 62-year-old Caucasian woman who resides in Florida had moderate, asymptomatic hypertension for five years. Her blood pressure was controlled on enalapril maleate 5 mg daily. Her pressure on this regimen varied between 115/75 to 120/82 mmHg. She had no complications from her hypertension. there was no history of stroke, angina, or left ventricular failure. The electrocardiogram and renal function were normal. She had no retinal abnormalities. She weighed 127 lbs (58 k). She had a ventricular demand pacemaker implanted two years previously for 'sick sinus syndrome'. She had a diffuse, moderately severe headache during the first two days after arrival as Aspen, Colorado {altitude 8,000 ft (2440 m).] Her blood pressure rose to 180/110 mmHg. She consulted a local internist, who administered nifedipine sublingually and started her on nifedipine (slow release tablets) 20 mg daily and clonidine 5 mg patches daily. On this regimen, her blood pressure was controlled to 110/80 to 130/100 mmHg and she no longer had a headache. She has had previous similar rises in blood pressure upon visiting Aspen. On one occasion, her pressure rose to 200/140 mmHg. She experiences only mild acute mountain sickness with each ascent.

The effect of altitude upon hypertension is illustrated by a record of twice daily blood pressures taken by a physician during a motor trip to the Rocky Mountains. Systolic and diastolic pressures rose with the altitude attained and decreased to subnormal levels after descent. There was no significant change in heart rate. The patient continued his usual medication, propranolol 40 mg daily throughout the trip.

At 9,300 ft (2850 m) the morning blood pressures were higher than were the evening pressures.<sup>21</sup> This is a reversal of the usual diurnal variation and could be related to a greater degree of hypoxia during sleep. Blood pressure elevations in hypertensive patients going to high altitude are not a trivial problem. Eight percent of adult visitors of Keystone, Colorado gave a history of prior hypertension and 26% of these individuals were taking medications for their hypertension.<sup>1</sup>

In 97 elderly subjects who travelled to Vail, Colorado for a reunion systolic and diastolic blood pressures were increased on the day of arrival and then declined over the next few days. Subjects with a history of hypertension had higher blood pressures on arrival. Four had systolic pressures above 180 mmHg. None experienced any symptoms.<sup>23</sup>

Patients with hypertension who go to high altitude should consult their physician in advance so that appropriate preventive measures can be employed. Usually, an increase in medication, low salt diet, and increased rest during the first few days of the altitude stay will suffice. If patients record their own blood pressures, a physician should be consulted if high pressures are encountered. Low flow oxygen and rest may be helpful. The appropriate anti-hypertensive medications for altitude-aggravated hypertension have not been determined. It is possible that beta blockers may not be effective in controlling high altitude blood pressure elevations. Altitude hypertension may be primarily related to increased sympathetic activity, and release of epinephrine and norepinephrine. Beta blockade lowers blood pressure primarily by reductions in cardiac output and plasma renin activity. Clonidine may be more effective in the management of altitude hypertension, since it produces diffuse inhibition of sympathetic neural outflow of the central nervous system.<sup>24</sup> Terazosin hydrochloride may also be more effective than beta blockers, since this preparation blocks alpha receptors and the rise in blood pressure during altitude exposure probably principally involves alpha adrenergic stimulation. Syncope may occur, but

can be obviated by omitting the evening dose.<sup>25</sup> Calcium channel blockers may also be effective. Nifedipine may be used if hypertension is severe and rapid reduction in blood pressure is desired. It is evident that controlled trials of several forms of medication at high altitude are indicated to develop more specific recommendations.

### Conclusion

In summary, ascent to high altitude may have significant effects upon cardiovascular disease. The most common complication is an increase in angina or new onset angina which occurs within a day or two after arrival. Systemic blood pressure may become elevated, especially in individuals with pre-existing hypertension. These complications are largely related to increased activity of the sympathetic nervous system. Physicians should be aware of these potential effects of altitude, so that appropriate preventive and therapeutic measures can be employed.



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Thursday, August 10, 1995

**RECENT ADVANCES  
IN HAPE**

*John West, MD*

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## LEARNING OBJECTIVES

### Recent Advances in High-Altitude Pulmonary Edema

1. Following this presentation, participants will be able to list the main clinical features of HAPE.
2. Following this presentation, participants will be able to discuss the current theories of pathogenesis of HAPE.
3. Following this presentation, participants will be able to discuss the therapy of HAPE in the light of new information on pathogenesis.

## RECENT ADVANCES IN HIGH-ALTITUDE PULMONARY EDEMA

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### High Altitude Pulmonary Edema is Caused by Stress Failure of Pulmonary Capillaries

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#### Abstract

*J. B. West and O. Mathieu-Costello.* High Altitude Pulmonary Edema is Caused by Stress Failure of Pulmonary Capillaries. *Int J Sports Med*, Vol 13, Suppl 1, ppS54-S58, 1992.

The pathogenesis of high altitude pulmonary edema (HAPE) is disputed. We propose that the mechanism is stress failure of pulmonary capillaries. The main features to be accounted for are the strong association with pulmonary hypertension, the high permeability characteristics of the edema, and the presence of inflammatory markers in the lung lavage fluid. When the capillary pressure is raised to about 40 mmHg in anesthetized rabbits, ultrastructural damage to the capillary walls is seen including breaks in the capillary endothelial layer, alveolar epithelial layer, and sometimes all layers of the wall. This results in a high permeability form of edema with the escape of high molecular weight proteins and blood cells into the alveolar spaces. In addition the basement membrane of the en-

dothelial layer is frequently exposed, and we suggest that this highly reactive surface attracts and activates platelets and neutrophils. The result is the formation of small thrombi which are frequently seen in HAPE, and the presence of inflammatory markers such as leukotriene B<sub>4</sub> and the complement fragment C5a in the lung lavage fluid. Hypoxic pulmonary vasoconstriction raises the pressure in some capillaries because the constriction is uneven. Since HAPE has its origin in the high pulmonary artery pressure, the objective of treatment should be to reduce the pressure by descent, administering oxygen, or giving drugs such as calcium channel blockers (e.g. nifedipine) which relax pulmonary vasoconstriction. Stress failure of pulmonary capillaries satisfactorily accounts for the features of HAPE.

#### Key words

Hypoxia, pulmonary circulation, rabbit, high permeability edema, inflammatory markers, vasoconstriction

### Introduction

The pathogenesis of high altitude pulmonary edema (HAPE) is still disputed. We believe that there is strong evidence that the mechanism is stress failure of pulmonary capillaries, and the purpose of this manuscript is to summarize the evidence.

Features of HAPE that need to be accounted for include the following:

- 1) Strong association with pulmonary hypertension (10, 11, 14).
- 2) Normal pulmonary artery wedge pressure (11).
- 3) Some susceptible persons have increased hypoxic pulmonary vasoconstriction (10).
- 4) Association with a restricted pulmonary vascular bed, for example in patients with unilateral absence of a pulmonary artery (7).
- 5) Association with exercise (8).
- 6) Edema is of the high permeability type with a large concentration of high molecular weight proteins and many cells (6, 17).
- 7) Edema fluid contains markers of an inflammatory response (17).
- 8) Vascular thrombi and fibrin clots are seen in the pulmonary vessels at postmortem (1).
- 9) Distribution of the edema is patchy as seen at autopsy or on the chest radiograph (11).

These features could be accounted for by the following:

- 1) Pulmonary hypertension is an important causative factor.
- 2) The pulmonary capillary wall is abnormal.
- 3) There is activation of leucocytes and platelets.

The objective of this presentation is to show that all the above features are readily explained by the mechanism of stress failure of pulmonary capillaries.

### Experimental Observations

Anesthetized rabbits were exsanguinated, the chest was opened, and the pulmonary artery and left atrium cannulated (18, 22). The lung was perfused with the rabbit's own blood for one minute at known pulmonary arterial and venous pressures. Then a saline/dextran mixture was infused to wash out the proteins, and this was followed by buffered glutaraldehyde to fix the lungs for electron microscopy. Pulmonary artery pressures of 20, 40, 60 and 80 cm water were used with pulmonary venous pressures 5 cm water below the arterial pressure, and an alveolar pressure of 5 cm water. This means that the capillary transmural pressures (difference in pressure between the inside and outside of the capillary) were 12.5, 32.5, 52.5 and  $72.5 \pm 2.5$  cm water.

Electron microscopic appearances were normal at the lowest capillary pressure. However at a capillary transmural pressure of 52.5 cm water (about 40 mmHg) and above, obvious ultrastructural damage was seen in the capillary walls including disruption of the capillary endothelial layer, alveolar epithelial layer, or sometimes all layers of the

wall. Figure 1a shows an example where the capillary endothelial layer is disrupted while its basement membrane remains intact as does the basement membrane of the alveolar epithelial cell and the alveolar epithelium itself. The capillary transmural pressure was 52.5 cm water. Figure 1b shows an example where the alveolar epithelial layer is broken on one side while the endothelial layer is disrupted on the other, and a platelet is adhering to the exposed basement membrane. In Figure 1c, all layers of the capillary wall are broken and a red cell is apparently moving out of the capillary lumen. Figure 1d shows a scanning electron micrograph illustrating breaks in the alveolar epithelium when the capillary pressure was 52.5 cm water.

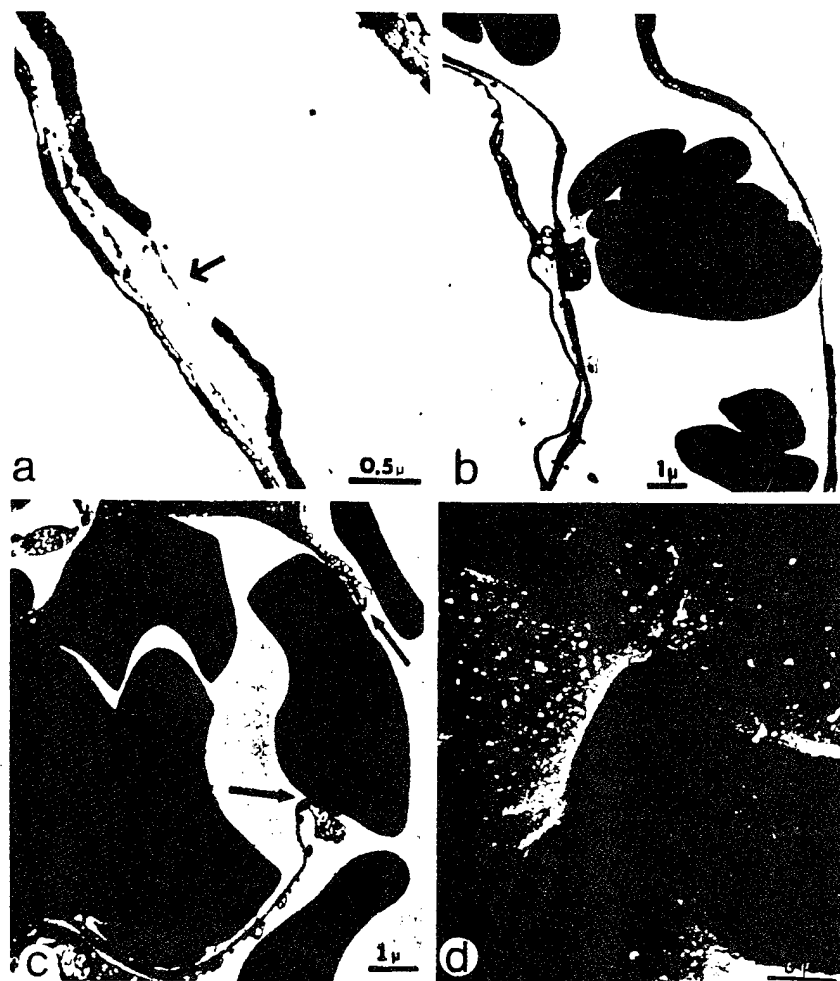
We consistently saw damage to the capillary wall at a transmural pressure of 52.5 cm water and above. When the pressure was raised to 72.5 cm water, the frequency of breaks increased (18). A few breaks were seen in rabbit lungs at a capillary transmural pressure of 32.5 cm water although most of these were in one preparation which was possibly abnormal for some reason.

### Physiology of Pulmonary Capillaries at High Pressures

We have analyzed the three principal forces acting on the capillary wall (22). The first is the hoop or circumferential tension caused by the capillary transmural pressure acting across a curved surface according to the Laplace relationship. This is the primary force causing damage to the wall as the capillary pressure is raised. The second important force is the surface tension of the alveolar lining layer. Because the capillaries bulge into the alveolar spaces at high pressures, we believe that the surface tension supports the capillaries just as iron hoops support a barrel of beer. The third force is the longitudinal tension in the alveolar wall associated with lung inflation. Some of this is transmitted to the capillary wall increasing the likelihood of stress failure. We have shown that at high lung volumes, the incidence of stress failure is very much greater for a given capillary transmural pressure (5).

Whether the capillary wall fails when the transmural pressure is increased depends on the wall stress. This becomes extremely high when the capillary pressure is raised to the levels we have studied. For example, in a capillary of radius 5  $\mu\text{m}$ , wall thickness on the thin side of 0.3  $\mu\text{m}$ , and capillary transmural pressure of 52.5 cm water, the calculated wall stress is 90 kPa, or  $9 \times 10^5$  dyn/cm<sup>2</sup> (22). This is an astonishingly high stress, being approximately the same as that in the normal aorta which is protected by large amounts of collagen and elastin. It is remarkable that previous investigators have not calculated the wall stress of pulmonary capillaries at increased pressure. Presumably it was assumed that the stress was low because of the small radius of the capillaries, but what was overlooked is that the wall is extremely thin. This requirement follows from the main function of pulmonary capillaries which is pulmonary gas exchange.

There is evidence that the strength of the thin side of the pulmonary capillary wall comes from the type IV collagen in the basement membranes of the endothelial and epithelial layers. Most of the type IV collagen appears to be confined to a central lamina densa of the extracellular matrix



**Fig. 1** Electron micrographs showing stress failure in pulmonary capillaries. **a)** The capillary endothelium is disrupted but the alveolar epithelium and the two basement membranes are intact. Capillary pressure 52.5 cm water. **b)** The alveolar epithelial layer (right) and capillary endothelial layer (left) are disrupted. A platelet is closely applied to the exposed endothelial basement membrane (left). Capillary pressure 52.5 cm water. **c)** Disruption of all layers of the capillary wall with a red cell passing through the opening. Capillary pressure 72.5 cm water. **d)** Scanning electron micrograph showing disruptions of the alveolar epithelial cells. Capillary pressure 52.5 cm water. **a)** and **b)** are from West et al. (22). **c)** is from Tsukamoto et al. (18).

which is only about 50 nm thick. Thus Nature's solution to providing a very thin but very strong capillary wall is to include a very thin sheet of extremely strong material in the center of the sandwich (21).

At first sight it may appear that a capillary pressure of 52.5 cm water (approximately 40 mmHg) is so high that it is of little physiological or pathophysiological interest. However there is good evidence that the capillary pressure at the base of the human lung rises to over 30 mmHg during heavy exercise at sea level (22). At high altitude, resting pulmonary artery pressures are much higher than at sea level because of hypoxic pulmonary vasoconstriction particularly in people prone to develop HAPE. For example, in a recent study, mean pulmonary artery pressures as estimated by noninvasive methods averaged 53 mmHg in a group of subjects who were susceptible to HAPE at an altitude of 4559 m (2). These pressures will rise substantially during exercise. If the hypoxic pulmonary vasoconstriction is uneven (see below) pulmonary capillary pressures will be much higher than at sea level.

There will be a sequence of physiological events as capillary pressure is raised from low normal levels. First fluid will move from the capillary lumen into the alveolar wall interstitium, and possibly into the alveolar spaces, as the Starling equilibrium is disturbed. This is the well known hy-

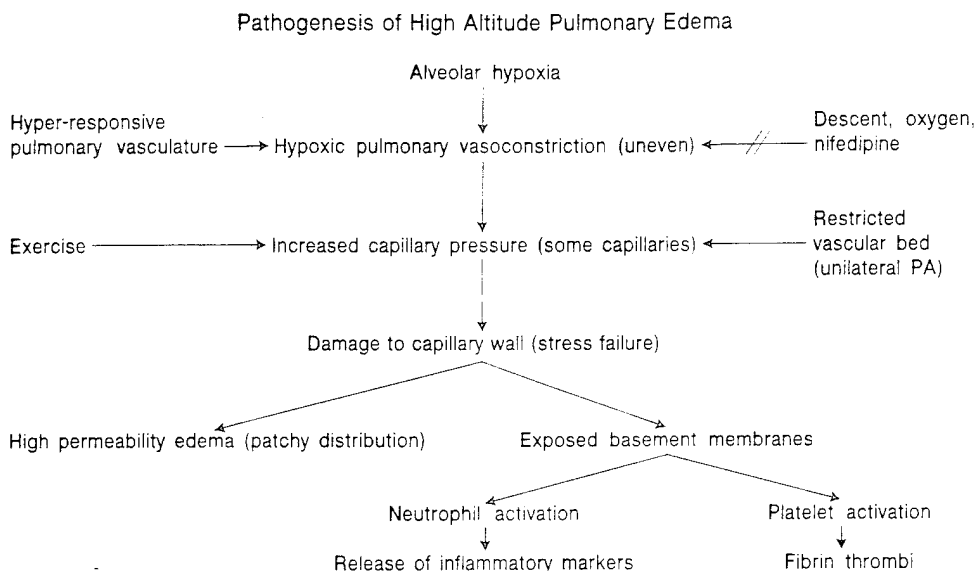
drostatic form of edema. At somewhat higher pressures, the phenomenon of "pore stretching" may be seen. This is controversial, but it has been shown that when the pulmonary capillary pressure is increased, large tracer molecules such as hemoglobin can move between the capillary endothelial cells into the interstitium of the alveolar wall (15). At even higher pressures, stress failure occurs with disruption of some or all layers of the capillary wall with the results that protein and even blood cells move out of the capillaries giving a high permeability type of edema.

Recent work in our laboratory indicates that at least part of the damage to the capillary wall at high pressures is reversible within a minute or so if the pressure is reduced (4). The breaks that close are those that are initially small and are associated with an intact basement membrane. This short-term reversibility of stress failure may play a role in the rapid improvement that takes place when someone with HAPE returns to a lower altitude.

#### **Evidence that Stress Failure is the Mechanism of HAPE**

All the features of HAPE listed in the Introduction can be explained by the stress failure hypothesis. Figure 2 is a diagram showing the sequence of events.





**Fig. 2** Diagram to show the sequence of events in the pathogenesis of HAPE. See text for discussion.

Alveolar hypoxia causes hypoxic pulmonary vasoconstriction. This will be most marked in those individuals who have accentuated pulmonary vascular responsiveness to hypoxia (10) but can be reduced by descent, oxygen administration, or calcium channel blockers such as nifedipine. A key step in the sequence of events is transmission of the high pressure to some of the capillaries. This presumably takes place because the hypoxic pulmonary vasoconstriction is uneven, as first suggested by Hultgren (9). The evidence for unevenness of hypoxic pulmonary vasoconstriction is indirect but strong. First there is the patchy distribution of edema described both at autopsy and in the chest radiograph (11). While all forms of pulmonary edema are uneven to some extent, the unevenness in HAPE is particularly marked. In addition, the uneven vasoconstriction is consistent with the patchy distribution of vascular smooth muscle in the adult lung. It is known that the small pulmonary arteries have large amounts of smooth muscle in the fetal lung, but much of the muscle undergoes involution early in postnatal life leaving the adult lung with irregular remnants of smooth muscle (3). This patchy, meager distribution of smooth muscle is consistent with the fact that there is great variation in the response of the adult pulmonary circulation to alveolar hypoxia between individuals (16), and the fact that the evolutionary pressure for the mechanism of alveolar hypoxic vasoconstriction comes from the events in the transition from placental to air breathing in the perinatal period. The mechanism has little if any selective advantage in the adult.

The uneven hypoxic vasoconstriction increases capillary pressure in those regions of the lung which are downstream of small pulmonary arteries that do not constrict, or constrict to a small extent. The increase in capillary pressure will be exaggerated by exercise thus explaining the importance of this factor in HAPE. The capillary pressure will also be abnormally high if the vascular bed is restricted, for example because of the absence of one main pulmonary artery. HAPE is known to be particularly prevalent in such subjects (7). The high capillary pressure causes damage to the capillary wall through the mechanism of stress failure as described above and illustrated in Figures 1a–d. The damage to the capil-

lary wall allows the escape of proteins including high molecular weight globulins, and also red blood cells (Figure 1c) and even leucocytes.

An important feature of stress failure is that basement membranes of the capillary endothelial cells are frequently exposed. Examples are shown in Figures 1a and b. The exposed basement membrane is electrically charged and highly reactive. Platelets, leucocytes and red blood cells adhere to the surface and can be seen in electron micrographs (Figure 1b). The resulting platelet activation will cause the formation of fibrin thrombi which are a feature of the pathology of HAPE (1).

Leucocyte activation will also result from exposure of these cells to the highly reactive endothelial cell basement membranes (13, 19). This activation will cause the release of leukotriene B<sub>4</sub>, other lipoxygenase products of arachidonic acid metabolism, and C5a complement fragment which have been described in the lung lavage fluid in patients with HAPE (17). Interestingly although the lung lavage fluid contains mediators of inflammation such as leukotriene B<sub>4</sub> and the complement fragment C5a, the fluid does not contain large numbers of neutrophils as in some other types of acute lung injury. This pattern is to be expected if the neutrophils are attracted to, and activated by, the exposed endothelial cell basement membranes within the capillaries.

Although there is strong circumstantial evidence that HAPE is caused by stress failure of pulmonary capillaries, it would be desirable to find the characteristic capillary ultrastructural changes in patients who have died from HAPE. This is a considerable logistical challenge because the tissue needs to be fixed for electron microscopy using buffered glutaraldehyde shortly after death to avoid autolytic damage. Furthermore the ultrastructural lesions are difficult to see in collapsed lung, and it would be best if the lungs are inflated prior to fixation. Since relatively few people die of HAPE now that the condition is so well recognized, we hope that readers interested in the pathogenesis of the condition will help us obtain lung samples if the opportunity arises.

One published study shows evidence of stress failure in the pulmonary capillaries of rats acutely exposed to a barometric pressure 265 mmHg for up to 5 hours in a low pressure chamber (12). The electron microscopic appearances included disruption of the type I alveolar epithelial cells, and damage to the endothelial cells causing the escape of red cells into the interstitium of the alveolar wall. Breaks in the pulmonary capillary walls were also reported in an earlier study of mice exposed to a simulated altitude of 30,000 ft. (9144 m) (20).

#### Acknowledgements

This work was supported by NIH Program Project HL17331-16.

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Thursday, August 10, 1995

**LIMITS OF  
PERFORMANCE**

*Bengt Kayser, MD, PhD*

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## LIMITS OF PERFORMANCE AT HIGH ALTITUDE

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MD PhD

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### *Aim:*

This presentation is aimed at providing some insight in the understanding of what limits exercise performance at high altitude. As a red thread the so-called 'lactate paradox' will be used. After attending the lecture the attendees will have learned what is presently known about this problem and which aspects need more research.

### *Abstract:*

The intensity of maximum exercise involving a large muscle mass that an acclimatized lowlander can sustain at altitude is reduced compared to sea level. In fact, exercise is stopped before the appearance of biochemical signs of peripheral fatigue. One possible hypothesis to explain the reduction of classical biochemical signs of fatigue in the muscle after exhaustive exercise at high altitude could be that a reduced central motor drive, induced by a maximally stressed respiratory system, would possibly limit such exercise with large muscle groups before their full potential is elicited. It appears that in controlled laboratory conditions up to 5050 m the muscular apparatus by itself remains in good condition and in principle capable for work, but this seems to be the case only when a small muscle mass is activated. Exhaustion time of dynamic forearm work at the identical absolute (maximum) load is the same at sea level and altitude, and similar signs of peripheral muscle fatigue develop before exhaustion is reached. By contrast, for similar exhaustion time, the absolute maximum cycling load maintained at 5050 m is ~20% lower than at sea level. Furthermore, while exhaustion during leg exercise at sea level is accompanied both by biochemical and electromyographical signs of peripheral fatigue of the leg muscles, this is not the case at high altitude. Thus, at altitude, reduced central motor drive rather than peripheral locomotor muscle fatigue limits exhaustive exercise carried out with large muscle groups. Such mechanism could, at least partially, explain the decreased accumulation of lactic acid in blood in acclimatized subjects during exhaustive exercise at high altitude ('lactate paradox') and may represent a possible strategy for preserving vital respiratory functions from failure at altitude. Indeed, at high altitude, the diaphragmatic contribution to ventilation during exercise at the same relative load decreases with time. This seems to be due to diaphragmatic fatigue, which hypothetically may contribute to exercise limitation at high altitude, although other mechanisms, like decreasing oxygen availability at the level of the central nervous system, may also play a role in limiting the duration of exhaustive exercise in conditions of chronic hypobaric hypoxia.

*Keywords:* exercise, lactic acid, muscle, fatigue, altitude, diaphragm, lactate paradox

*Recommended reading:*

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Thursday, August 10, 1995

# NATURAL HAZARDS

*Jack Ives, PhD*

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## NATURAL HAZARDS

Mountains can be regarded geomorphologically as "high energy" environments. The very steepness of slope, extreme altitudes, and often severe weather associated with them not only provide the grandeur and adventure that so many of us seek, they also result in violent processes of nature usually referred to as natural hazards. These include avalanches, rockfalls, landslides, floods, and outbreaks of glacier lakes, as well as the direct and indirect effects of highly active plate tectonics - the very basis of mountain building.

To these "natural" events we must add the negative impacts of unwise human interference with slope stability ranging from deforestation for logging or for extension of subsistence agriculture, to highway and hydroelectric facility construction. Recent research, however, has demonstrated that satisfactory interpretation is far from complete. We need a much fuller understanding, and a much better data base, before we can achieve a rational approach to mountain resource development. One of the greatest challenges in this respect is how to deal with high magnitude events that occur only very infrequently - with return periods of 200, or even 500 years or more.

Examples of mountain hazards, from the Colorado Rockies, to the Himalaya, Pamirs, Alps and the Andes will be illustrated with a series of Hasselblad medium format color slides.

Jack D. Ives, President, International Mountain Society.

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Thursday, August 10, 1995

**RECENT ADVANCES IN  
AVALANCHE SURVIVAL**

*Bruno Durrer, MD*

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# RECENT ADVANCES IN AVALANCHE SURVIVAL

DURRER Bruno, BRUGGER Hermann

Skiing and skialpinism are fascinating wintersports but the risk of triggering an avalanche makes them also the most dangerous wintersports, claiming every year about 150 lives in the Alps alone.

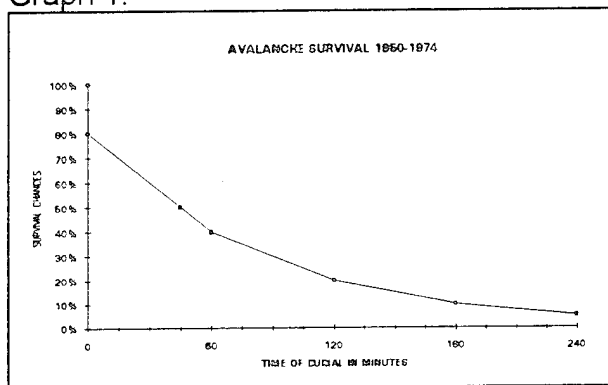
Prophylaxis remains the only reliable safeguard for the individual and not getting into an avalanche is the best and most efficient way of avalanche survival. However, optimal training, best equipment and experience provide no life guarantee, and may even sometimes induce a false sense of security. According to our statistics, death after burial in an avalanche is caused by asphyxia in about 80% of cases, by injuries in 10-15%, and by accidental hypothermia in 5% at most.

Whenever people are buried in an avalanche people, it is very important for optimal survival chances that the companions of the victims react properly on site and that the rescue team as well as the medical team works efficiently.

## 1. AVALANCHE SURVIVAL CHANCES

Using data on all avalanche victims in Switzerland from 1950 to 1974 (N. 481, with 231 dead (48%)), the survival chances were calculated by M. Schild in relation to the time of burial. At the moment the avalanche stopped, the chances were 80%. After one hour they decreased to 40%, after two hours to 20%, after three hours to 10% and after 4 hours to 5% etc. All rescue directives to date were based on the survival function proposed by Schild. Graph 1.

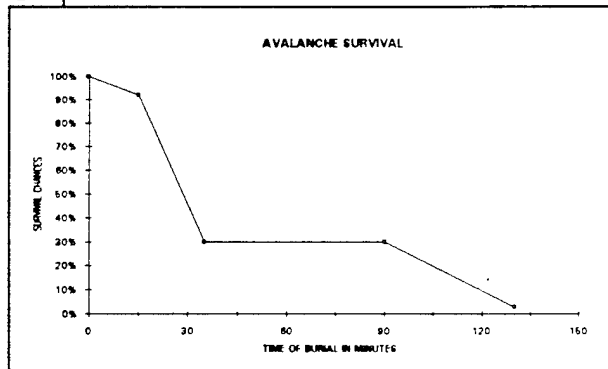
Graph 1.



Using the data from 1981 to 1991, the survival probability was calculated by Brugger and Falk again and a new computer assisted procedure allows estimation of survival chances with far greater accuracy.

The minuted rescue data of 422 buried skiers was analysed. 241 (57%) were dead on extrication. The mean depth of burial under the snow (head) was  $105 \pm 85$  cm. The poor results on extrication of deeply-buried skiers reflect the generally prolonged rescue time involved. The fundamental difference in survival function lies in the steep drop of the present curve at 15 min until 35 min, with a further dip commencing at about 90 min. Graph 2.

Graph 2.



The only finding giving ground for optimism is that the initial survival probability is much higher than previously assumed. Indeed, of the 123 skiers extricated within 15 min, only 8 were dead and, moreover, only 2 had died of asphyxia (extrication time 10 and 15 min), whereas the remaining 6 skiers died because of fatal injuries.

The survival probability then plummets from 92% at 15 min to only 30% at 35 min, in contrast to the hitherto-accepted gentle decrease from 67 to 55% over the same period. This fatal drop results from acute asphyxiation of all victims without an air pocket.

The constant survival chances between 35 and 90 min indicate that for the buried persons with an air pocket, the risk of dying is minimal for the next 55 min. It is known that the snow cover prevents rapid hypothermia (maximally 3°C per hour) and that oxygen consumption decreases significantly with lowering of the body temperature and loss of consciousness.

The survival probability then falls from 27% at 90 min to only 3% at 130 min. Hence, victims with a closed air pocket eventually succumb between 90 and 130 min after descent of the avalanche. Death is due to a combination of "slow asphyxia" and hypothermia. The decrease in body core temperature appears to be slowed down if oxygenation is adequate, especially with an "open" air pocket. Thus, in the absence of fatal injuries, speed of extrication from the avalanche and existence of an air pocket are the decisive factors determining survival.

This reassessment of survival probability has far-reaching implications for recommended rescue strategies, emphasizing the importance of rapid and efficient help by uninjured companions and explaining the low success rate achieved by organized rescue parties.

Reduction of the present high mortality rate depends on increasing the proportion of skiers freed within 15 min, which realistically, means by uninjured companions. Professional help should be sought immediately after, but not during this critical phase.

The fact that there was no decline in the annual mortality rate between 1981 and 1991, despite increasing standards of professional rescue techniques and medical emergency back-up services, is largely explained by the difficulties in mobilizing mountain rescue teams within the brief optimum survival time.

We believe that mountaineering organisations should teach skiers mandatory safety precautions, as well as the basic techniques of searching, extracting and resuscitating avalanche victims. At present many skiers carrying rescue transceivers

are insufficiently familiar with their use, with fatal consequences.

Recent first experiences with the skiers airbag are promising better survival chances, but more data is needed. An additional essential step would be to develop self-help techniques to facilitate creation of a life-saving air pocket, which would give the skier a relatively safe haven for about 90 min which is the new time goal set for professional rescue.

## 2. PRACTICAL ASPECTS OF THE MEDICAL ON SITE TREATMENT OF AVALANCHE VICTIMS

In the practical rescue work and for the instruction of the non medial rescue staff we distinguish between five stages of hypothermia. As criterias we use the degree of consciousness, the presence of muscular tremor, the cardial activity and the core temperature.

HT I:	Clear consciousness with muscular trembling	Coretemp.C°:	35 - 32
HT II:	Impaired consciousness without muscular trembling		32 - 28
HT III:	Unconsciousness		28 - 24
HT IV:	Apparent death		24 - 15 ?
HT V:	Death		< 15 ? (< 9 ?)

From the practical point of view the on site emergency doctor gets confronted with the following problems:

### 2.1. TRIAGE OF AVALANCHE VICTIMS WITH ASYSTOLE BY THE ON SITE EMERGENCY DOCTOR (Table 1)

The successful use of ECC (extra corporeal circulation) in hypothermia treatment led in the 80's to no avalanche victim without fatal injuries being declared dead before clinical rewarming (Nobody should be considered dead until warm and dead). This principle led to numerous attempts at therapy with ECC. But with asystolic avalanche victims the results were disappointing, because in most buried victims cardiac arrest is caused by asphyxia and not by hypothermia.

For triage of avalanche victims not fatally injured the differential diagnosis between asphyxia and severe hypothermia plays a central role. The diagnostic criteria presented here are based on the latest information on the pathophysiology of hypothermia in burial by avalanches:

In all those buried in avalanches without an air pocket, death occurs through acute asphyxia, within 45 minutes after burial. After this time the existence of an air pocket forms the main criterion for triage.

In hypothermic patients the danger of circulatory instability begins when a critical core temperature of 32° Celsius is reached. This temperature is achieved by those buried in avalanches, as a rule after 90 minutes, but not before 45 minutes, based on average rate of cooling of 3° Celsius per hour.

The measurement of core temperature for triage is made epitympanically and/or oesophageally directly after extrication from the snow. A later measurement must not be used for triage, because after rescue there will be further cooling of the victim. After a longer period of cardiac arrest, the epitympanic measurement gives a lower value than the oesophageal owing to the lack of carotid flow. Therefore oesophageal measurement is to be preferred in this case.

For safe triage at the scene of the accident, the emergency doctor must take part in the rescue of the victim and should reach the avalanche field with the first helicopter flight or with the top group. Prior to establishing death in the mountains, the emergency doctor must exclude a HT IV. Recently in some clinical centres even patients with polytrauma can be rewarmed with ECC. Consequently the rescue doctors have to decide whether there is a HT IV with additional injuries or a dead patient due to lethal injuries and subsequent cooling down.

To aid in triage he needs an ECG and a field thermometer for epitympanic and/or oesophageal core temperature measurement. A not properly indicated resuscitation can put the rescue team under unnecessary risks, especially if there are risks of second avalanches or ice- and stonefall.

#### AT THE RESCUE: (TABLE 1)

- A) Assess whether an **air pocket** exists or not. Each cavity in front of the mouth and nose, even if it seems to be very small and confined, is to be declared an "air pocket". The statement "no air pocket" can be made only if mouth and nose of the patient are blocked airtight by avalanche snow (or débris).
- B) Check whether fatal injuries exist or not.  
If no carotid pulse: Start **resuscitation**, with ECG control.
- C) If asystolic: Measure **core temperature** epitympanically or oesophageally. If measurement of the core temperature is not possible, the **time of burial** further helps as a criterion for triage.

1. **The core temperature is higher than or equal to 32°C or the time of burial is shorter than or equal to 45 minutes:**

The existence of a circulation-endangering hypothermia is excluded; assume cardiac arrest is due to acute asphyxia. The chance of successful resuscitation sinks to zero within a few minutes of cessation of breathing (warm and dead). An attempt at resuscitation is indicated in all cases, because in the most favorable instance, breathing may have stopped only moments before rescue. If this is successful, the victim should be sent to a hospital with an intensive care unit. Resuscitation without success can be stopped after 20 minutes and "death by choking" can be confirmed at the scene of the accident.

2. **The core temperature is lower than 32°C or the time of burial is longer than 45 minutes:**

Asystole can be caused both by asphyxia and by hypothermia. To proceed further information about the existence or absence of an air pocket is decisive. This information can be used by the emergency doctor only if it is authentic, i.e. if he himself is present at the rescue or receives the information directly from the person who carried out the rescue.

**a) Air pocket present and airway free:**

Suspect stage IV hypothermia. Resuscitation must be continued without a break until admission to a hospital with ECC. Recent reports indicate that even patients with polytrauma can be successfully rewarmed with ECC. Actually the lowest core temperature of a patient successfully resuscitated is at 15,2°C. Although there is one reported case of induced hypothermia with 9°C, we recommend to evacuate first victims with a core temperature above 15°C.

**b) No air pocket present and mouth and nose closed airtight by snow:**

In this case death has already occurred soon after burial. The emergency doctor can break off resuscitation and diagnose "death through asphyxia with subsequent cooling down".

**c) Air pocket questionable:**

If information of an air pocket is uncertain and the airway is open, resuscitation must be continued, as stage IV hypothermia cannot be excluded with certainty. Send the victim to a hospital with ECC equipment. In some circumstances the patient can be flown to the nearest hospital in order to determine serum potassium. If this is higher than 10 mmol/l death can be established.

The determination of the serum potassium at the site of accident is in evaluation at the time.

TABLE 1

# **AVALANCHE VICTIMS WITH ASYSTOLE - TRIAGE BY THE RESCUE DOCTOR AT THE SITE OF ACCIDENT**

Examine the victim during extrication from the snow (Airpocket, Airways)			
↓			
Cardio Pulmonary Resuscitation (CPR) (ECG → Asystole)			
CORETEMPERATURE 32°C OR ABOVE OR TIME OF BURIAL 45 MIN. OR BELOW	↓	CORETEMPERATURE BELOW 32°C OR TIME OF BURIAL ABOVE 45 MIN.	↓
Continue CPR for 20 minutes successful: → clinic with Intensive Care Unit	↓	AIR POCKET PRESENT: Continue CPR → Clinic with ECC	AIR POCKET UNCERTAIN: Continue CPR → clinic with ECC or → nearest clinic with ICU: 1) potassium <10mmol/l: → clinic with ECC 2) potassium > 10 mmol/l: "Death probably by asphyxiation"
not successful: Stop CPR: "Death by asphyxiation"		NO AIRPOCKET Stop CPR: "Death by asphyxiation with subsequent hypothermia"	
Priority of transport: Coretemperature: >15°C (>90°)			
LETHAL INJURIES: "Death by trauma"			

## 2.2. MEDICAL ON SITE TREATMENT OF AVLANCHE VICTIMS:

### HT IV:

As soon as the diagnosis of HT IV is confirmed, resuscitation starts (including intubation and ventilation with humidified warm oxygen).

Whether or not a HT IV should be prevented from further cooling out, is a matter of discussion (metabolic icebox vs. irreversible core temperature). During the rescue and the transport there is always the risk of the core temperature decreasing beyond the reversible limits. For this reason most rescue doctors consider a proper protection against further cooling out in HT IV as necessary. This is ususally done with insulation and heat packs on the trunk. I.v.medication and perfusions are considered to be of no use in HT IV. We recommend to transport the victim to a hospital with ECC.

### HT III:

Whether it is absolutely necessary to intubate a HT III patient at the site of accident is still a matter of discussion. In the Alps a patient is evacuated by helicopter within 15 to 20 minutes to a medical center and the risk of a further heat loss during the treatment and transport has to be evaluated in relation to the advantages of an intubation. For the intubation an IV line is needed for the application of medicaments. In HT III peripheral vessels are difficult to locate and it takes usually quite some time to do an IV. A very careful handling helps to avoid life-threatening arrhythmias. We recommend to transport the victim to a hospital with ECC.

### HT II:

In case of a victim having an impaired consciousness a very careful handling is necessary to avoid life-threatening arrhythmias. If swallowing is possible, hot and sweet drinks are recommended. Strict supervision is necessary. We recommend to transport the victim to a hospital with ICU

### HT I:

Injuries in the mountains are often combined with mild hypothermia. Changing of wet clothes, hot drinks and insulation help to prevent a further cooling out of the patient. Uninjured victims do not have to be transported to a hospital in all cases.

On-site treatment of avalanche victims is "the art of the possible". With an increasing experience of measuring core temperatures at the site of accident we will gather more information on the optimal treatment and on the limits of reversible core temperature and many of the questions we have today, will hopefully clear up in the future.

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°INT.COMMISSION FOR ALPINE EMERGENCY MEDICINE



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Thursday, August 10, 1995

**CANADIAN MOUNTAIN  
RESCUE:  
STATE OF THE ART**

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*Material will be available at the presentation*

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Thursday, August 10, 1995

**HIGH ALTITUDE  
HEMATOLOGY**

*Jean-Paul Richalet, MD*

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# HIGH ALTITUDE HEMATOLOGY

Jean-Paul Richalet

Professor of Physiology  
Faculté de Médecine  
Bobigny, Paris, France

## Objectives :

Two main hematological aspects concern people willing to go to high altitude. It should be reminded that :

1) **Hemoglobin** is essential for oxygen transport, especially during exercise at high altitude. Thus, **anemic** persons or patients with **abnormal hemoglobin** should be detected and advised, and anemia corrected, if possible, before departure to high altitude

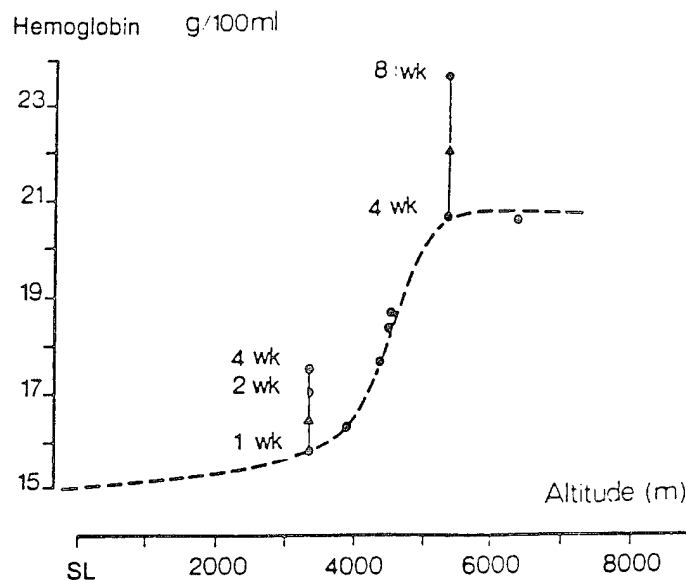
2) Altitude exposure may induce alterations of blood **coagulation**. **Thrombotic** diseases may occur, favored by these alterations as well as by **dehydration**. Susceptible subjects should be detected and advised on how to avoid dehydration, blood hyperviscosity and thrombosis.

Altitude exposure has an impact on two main aspects of blood function: **red cell function and coagulation**. The influence of altitude on white cells and on immunological function has been scarcely studied and will not be mentioned here.

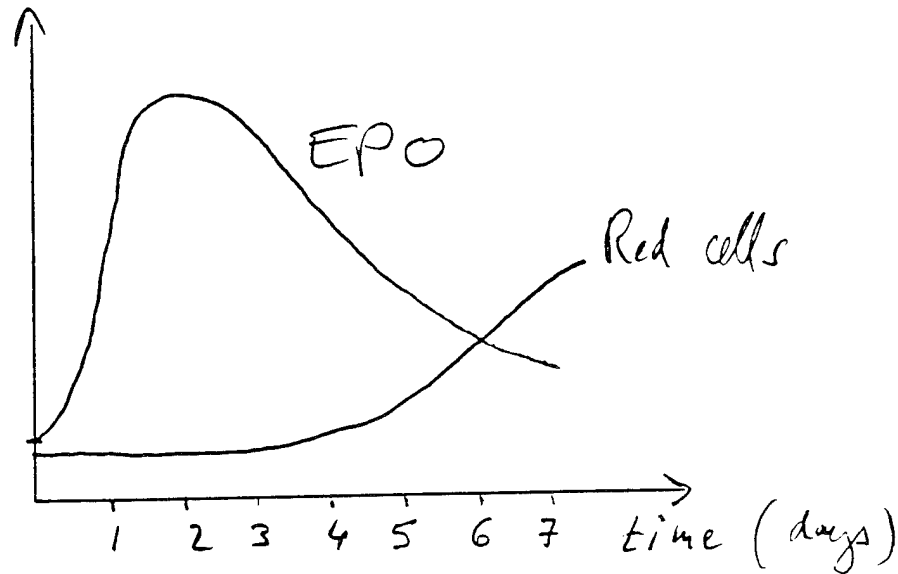
## Altitude and red cells.

After the initial increase in ventilation and heart rate in order to increase the  $O_2$  flux to the cells, the stimulation of erythropoiesis is an essential mechanism which increases the  $O_2$  transport capacity of the blood, thus allowing a secondary return of cardiac output towards basal values.

Intensity of hemoglobin increase at high altitude depends on **how high you go** and **how long you stay**.

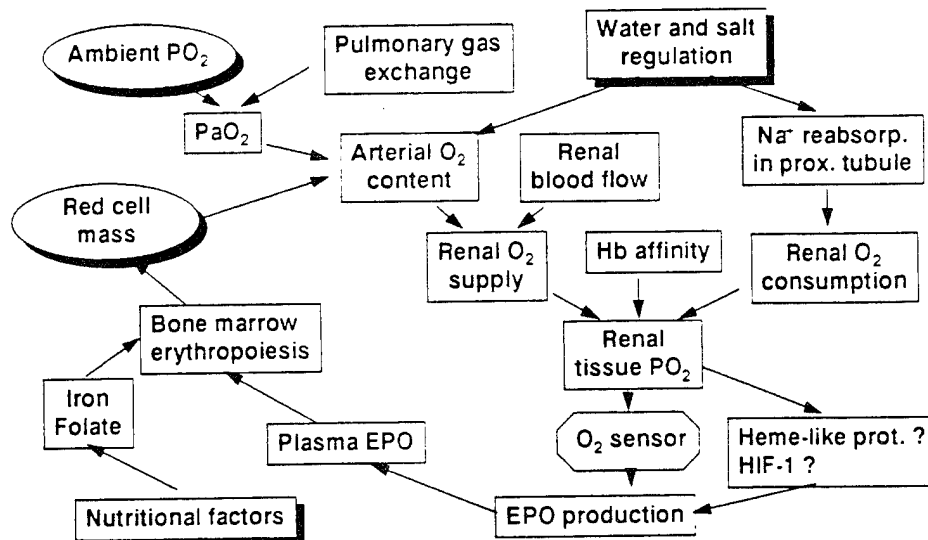


**Serum erythropoietin** is rapidly released by the kidney (a few hours after onset of hypoxic exposure) but it takes 5 to 7 days to see a significant increase in hematocrit or hemoglobin concentration.



**Control of erythropoiesis** depends on many factors, but the initial triggering phenomenon is the **secretion of erythropoietin** by the kidney, induced by renal tissue hypoxia

### Regulation of EPO production



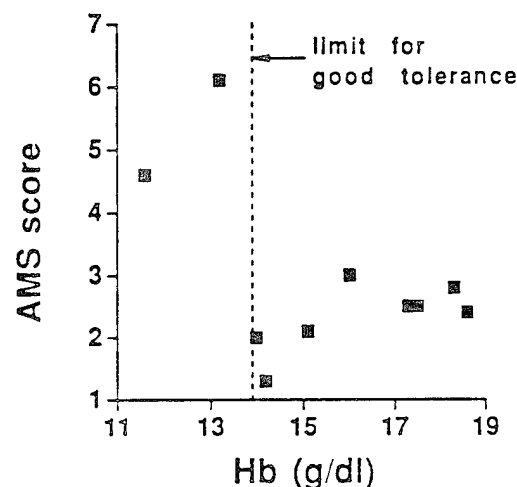
**Nutritional factors** interfere with red cell production since substrates are necessary for erythropoiesis : **iron and folates**.

- The level of red cell mass and iron stores much be checked before a prolonged exposure to altitude (3 weeks or more above 3,500 m ):
  - hematocrit > 40 %
  - hemoglobin concentration > 14 g/dl
  - serum ferritin > 50 µg/l
- Women are at risk since they have lower iron stores

**How much red cell mass do we need for a high altitude expedition ?**

.... enough but not too much !

Anemia is predisposing to an unsuccessful acclimatization but excessive polycythemia is a factor of thrombosis and altered microcirculation.  
The optimum range is between **14 and 18 g Hb / 100 ml blood**.



**Abnormal hemoglobins** may be a contra-indication to the exposure to altitude.

In sickle-cell disease, 80 to 100 % of the hemoglobin is in the S form, and 0 to 20 % the A form.

An abnormality in the beta chain of the hemoglobin makes the red cell dense and rigid when deoxygenated, leading to decreased red cell deformability and capillary obstruction.

Homozygous subjects with sickle-cell disease have symptoms at sea level and cannot go to high altitude.

In sickle-cell trait, 20 to 40 % of the hemoglobin is in the S form. Heterozygous subjects are asymptomatic at sea level but may develop symptoms at high altitude (sometimes as low as 1,500 m, generally above 3,000 m) : abdominal pain, splenic infarction, pulmonary infarction, ...

Subjects at risk must be informed of this problem.

## Altitude and blood coagulation.

### *Platelet count at altitude*

Only small changes in platelet counts have been described in humans at high altitude. A reduction in platelet count has been found by some authors in subjects suffering from Acute Mountain Sickness.

### *Coagulation at high altitude*

No important changes in the various factors of blood coagulation were found in subjects with normal acclimatization to high altitude.

However, thrombotic or hemorrhagic diseases are described :

- cerebral infarction, cerebral venous thrombosis
- retinal hemorrhages,
- pulmonary embolism, ...

Thrombosis were found in post mortem studies on subjects who died from pulmonary or cerebral edema.

Alteration of blood coagulation parameters were found in subjects during the development of pulmonary edema.

However, it is not clear if these changes are the cause or the consequences of high altitude- related diseases.

From a practical point of view, all factors which favor blood coagulation should be carefully controlled:

- **dehydration** favoring increase in blood viscosity and stasis:  
in some conditions, up to 5 liters of water per day are necessary to compensate the water loss during high altitude trekking
  - medical treatment altering hemostasis such as **contraceptive pills**.
- Some authors advise to stop estroprogestative treatment in women who intend to stay more than two weeks above 3,000 m.

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Thursday, August 10, 1995

# DIVING AT ALTITUDE

*Eric Johnson, MD*

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## DIVING AT ALTITUDE

Presented by: Eric L. Johnson, M.D.  
Idaho Emergency Physicians  
Rocky Mountain Center for Wilderness Medicine  
Consultant in Wilderness, Diving and Hyperbaric  
Medicine

As recreational diving continues to grow at a rapid pace, along with a large number of divers without ready access to sea level diving, there has been an increase in the number of divers exploring inland lakes, dams, quarries and rivers, many of these at higher elevations. It is important to understand the pressure changes and environmental impacts that confront the diver diving above sea level.

### LECTURE OBJECTIVES:

1. appreciate the pressure/environmental/physiological changes seen at altitude.
2. understand how equipment may be affected by diving at altitude.
3. to briefly review diving tables and modification of such at altitude.
4. review ways to minimize decompression illness at altitude.

### ENVIRONMENTAL CHANGES:

- reduced atmospheric pressure
- temperature extremes of air and water.
- usually fresh water, decreased density.
- water visibility changes.

### ENVIRONMENTAL CHANGES-----PHYSIOLOGICAL/EQUIPMENT:

- 1) REDUCED ATMOSPHERIC PRESSURE.
  - a. physiological changes and acclimatization
    - acute altitude illnesses
    - hypoxemia
    - dehydration
  - b. alteration of dive tables/algorithms.
  - c. affect of depth-measuring devices.
  - d. buoyancy changes to wetsuits.
- 2) TEMPERATURE CHANGES.
  - a. air/water temperatures are usually much colder, requiring wet/dry suit diving.
    - change in weighting
  - b. alteration in dive tables/algorithms.
  - c. physiological risks...hypothermia.
- 3) FRESH WATER DIVING... change in buoyancy.
- 4) WATER VISIBILITY CHANGES.
  - a. usually marked decrease in visibility.



#### BUOYANCY:

- freshwater is less dense than salt water, requiring removal of weight to establish neutral buoyancy....approximately 2.5% of total diver weight.
- wetsuits usually required due to water temperature... and due to reduced atmospheric pressure, increase buoyancy. This mainly is of concern near the surface and not a factor at depth.
- these effects tend to offset one another partially.

#### EQUIPMENT:

- 1) increased thermal protection required (wet/drysuits).
- 2) weight and buoyancy changes.
- 3) depth gauges(DG):

Most depth gauges are calibrated for salt water at sea level. Changes are approximately 3% for a gauge that is used in fresh water, yet calibrated for salt water. With these particular DG's, when we dive in fresh water, we are actually 3% deeper than is indicated by our gauge.

##### a. capillary DG.

Does not measure pressure directly, but measures ratios utilizing Boyle's law. This gauge reads 33 fsw(feet sea water) whenever depth pressure is twice surface pressure. As a result, the capillary DG will always indicate a depth greater than the actual depth. No correction required for less than 1000ft, and if true depth is required, subtract 3% of its reading per 1000ft elevation. (noted to work well at altitudes greater than 3000ft) However, the capillary DG gives an equivalent sea-level depth, allowing the diver at altitude to directly enter the "tables" with capillary DG readings.

##### b. bourdon tubes, non-zero adjust diaphragm.

Measures absolute pressure and hence, will indicate depths that are shallower than the actual depth. Actual depth is approximately 3% shallower than indicated for each 1000ft elevation. At 6000', a bourdon gauge at 38 fsw actual depth will register only 30 fsw.

##### c. computers.

Most new computers will read atmospheric pressure and automatically adjust for it. Will read actual depth.

#### TEMPERATURE CONCERNS:

- a. increased thermal protection due to cold waters.
  - wet/drysuit diving
  - earbarotrauma secondary to tight hood
  - consideration of "thermoclines"
- b. risk of hypothermia in/out cold water/air.
- c. possible risk of hyperthermia with gear on.
- d. if cold, recommend conservative approach with using dive tables
- e. concern of dehydration...increases risk of DCS.

#### VISIBILITY:

Many lakes, reservoirs, quarries have poor visibility, as well as silty bottoms which can dramatically worsen visibility if disturbed.

concerns: increased anxiety/panic  
increased air consumption with anxiety

#### REDUCED ATMOSPHERIC PRESSURE WITH ALTITUDE:

- a. buoyancy changes.
- b. affect on equipment, esp. DG.
- c. alteration/correction of dive tables/algorithms.

Most current dive tables are based on the concept of critical nitrogen tensions and ratios, whereby if tissue  $N_2$  pressure/ambient pressure exceeds a particular value, bubbles will form and risk of DCS substantially increases. As one ascends to altitude, our tissues contain a higher relative nitrogen pressure than found at destination altitude ambient pressure. Nitrogen will then be "off-gassed" until equilibrium is established at ambient pressure, taking approximately 12-24 hours. Divers who quickly ascend to altitude and immediately dive prior to equilibration, will have more tissue nitrogen and the critical tension may be exceeded. Similarly, as we ascend from diving at altitude, we ascend to an atmospheric pressure which is less than 1 ATA, this may cause the nitrogen critical ratio to be exceeded with the subsequent formation of bubbles and increased risk of DCS. Hence, standard tables based on sea level values cannot be safely used for altitude diving.

Many dive tables exist and whichever one is used, it must be understood, and/or corrected for altitude diving. We will look at a few which are frequently used or suited for altitude use.

##### (1) U.S. NAVY TABLES, CROSS CORRECTION.

The Cross correction utilizes a "theoretical ocean depth" (TOD) for a dive at altitude, then uses the standard Navy tables.  $TOD = \frac{\text{actual depth} \times \text{sealevel atm pressure}}{\text{atmospheric pressure at altitude}}$

This system applies to acclimitized divers who have been at altitude for 12-24 hours.

For example: 7000' dive to actual depth of 30fsw

$$TOD = \frac{30 \times 760}{586.4 \text{ mmHg}} = 38.9$$

Thus use 40' on standard tables which gives a NDL of 200 min.

Also noted on the Cross TOD tables, ascent rates are correspondingly reduced for each altitude.

If a diver ascends to altitude and dives immediately without acclimatization, the diver is assigned a repetitive group (due to increased nitrogen levels) and utilizes the Cross tables to calculate NDL (no deco limits).

eg. What is NDL for a 60ft dive at 6000' for acclimitized and non-acclimitized divers?

acclimitized = 40 minutes

non-acclimitized = 10 minutes.

(2) PADI REPETITIVE DIVE PLANNER AT ALTITUDE.

Notes: from 1000-10,000ft.  
must wait 6hrs prior to diving or use special procedure.  
rate of ascent may not exceed 30 ft/min  
no more than 2 dives/day.  
uses theoretical depth at altitude.  
uses 3 min safety stop on all dives.  
24 hrs wait recommended prior to flying after diving.

(3) SWISS ALTITUDE (BUEHLMANN) PROCEDURE.

Notes: has been extensively tested.  
assumes diver has not been acclimitized to altitude.  
3 tables: SL-700m/701-2500m/repetitive dives  
max ascent rate of 10m(33ft)/minute.

(4) DCIEM (DEFENSE & CIVIL INSTITUTE OF ENV.MED.)-CANADA

Notes; tested during working dives in cold water.  
assumes acclimitized diver(12hrs at altitude) and must  
be modified for non-acclimitized divers.  
provides a TOD called effective depth.  
more conservative than Cross correction.

(5) NAUI.

(6) Computers.

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U.S.NAVY(ACCLIM)	USNAVY(UNACCLIM)	SWISS	DCIEM
40 min	10 min	44 min	25 min
NDL at 60 ft at 6000 altitude.			

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d. physiological changes and acclimitation.

- moderate/high altitude illnesses.
  - AMS, HAPE, HACE.
- hypoxia after diving.

A diver breathing a gas with a higher oxygen partial pressure ascends to an atmosphere in which the ambient oxygen pressures are lower...may lead to hypoxia if diver exerts.

- dehydration.
- risk of excess sun exposure.
- poor sleep patterns.
- fatigue.

\*\*all may affect ability to dive, as well as risk of DCS.

## PRECAUTIONS/RECOMMENDATIONS FOR DIVING AT ALTITUDE:

1. acclimitize
2. increase oral fluids
3. know your equipment and buddy
4. minimize work and exertion out of the water
5. recommend new generation computer for repetitive or high altitude diving
6. recommend alternate air source (ie.spare air)
7. be conservative with depth/time/tables if at altitude or very cold
8. ascent rates no more than 30 ft/minute
9. limit dives to no more than 3 dives/day
10. do not dive above 10,000ft using modified tables... seek further help and information
11. safety stop for 3-5 minutes in the 10-20fsw depth
12. SIT minimum of 1 hour
13. tables: DCIEM- conservative and tested  
Buehlmann- easy and tested at altitude  
Cross- commonly used

CONTINUE TO LEARN!!!!!!!!!!!!!!

### Resources:

#### Books

Lippmann, John (1990), "Deeper into Diving". J.L.Publications.  
Wienke, B.R. (1993), "Diving Above Sea Level". Best Publishing Co.  
U.S. Navy Diving Manual, 1993.

#### Organizations:

Info related to altitude diving may be obtained from standard certifying agencies...NAUI, PADI.

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Thursday, August 10, 1995

**THE OLD, THE YOUNG  
AND THE UNBORN  
AT ALTITUDE**

*Stacy Zamudio, PhD*

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**SECOND WORLD CONGRESS ON WILDERNESS MEDICINE  
THE OLD, THE YOUNG, AND THE UNBORN AT HIGH ALTITUDE  
Thursday, August 10, 1994 3:40-4:30 P.M.**

This session reviews data from clinical and epidemiological studies of disease in the young, the old and the unborn acutely and chronically exposed to moderate to high altitude. The data reviewed are derived primarily from investigations in the USA and Europe. This session emphasizes data on the influence of altitude on pregnant women, neonates and infants in relation to pregnancy outcome and infant health. Since AMS and HAPE are discussed in separate sessions in the Thursday morning program by distinguished physician-researchers with a long history of investigating these disorders, the afternoon session considers epidemiological rather than clinical aspects of AMS, HAPE and HACE.

**Following this presentation, participants should be able to:**

1. State the frequency with which persons in various age groups travelling to moderate to high altitude develop AMS, HAPE or HACE and the factors associated with an increased risk of developing AMS, HAPE or HACE.
2. Discuss the evidence for or against aggravation of preexisting chronic disease during acute altitude exposure.
3. Understand the interaction between altitude exposure and pregnancy (both in acute and chronic altitude exposure) and discuss some of the mechanisms which contribute to the increased rate of pregnancy complications and lowered birth weight at high altitude.

**Acute altitude exposure: travelling to high altitudes for the young, the old and the unborn**

1. Overview
  - A. Travellers to high altitudes
2. Acute Illness - Acute Mountain Sickness (AMS), High-Altitude Pulmonary Edema (HAPE), High-Altitude Cerebral Edema (HACE)
  - A. Incidence by age group, sex
  - B. Factors associated with an increased risk of developing AMS, HAPE or HACE
  - C. Treatment/prevention
3. Aggravation of chronic illness, especially in the elderly
  - A. Hypertension, cardiovascular disease, pulmonary disease
  - B. Treatment, precautions to prevent or attenuate altitude-associated aggravation of disease
4. Special considerations: the pregnant woman and her fetus
  - A. Physiology of normal pregnancy and potential alterations during acute altitude exposure
    - 1) Shifts in plasma volume, exercise-induced desaturation, and potential impact upon fetal O<sub>2</sub> delivery

**Chronic altitude exposure: the young, the old and the unborn living at high altitude in the USA**

1. The unborn - the juncture between an individual's adaptation to altitude and the survival of the population
  - A. Reduction in infant birth weight, increased incidence of maternal complications of pregnancy
  - B. Alterations in uterine blood flow, pelvic blood flow distribution and blood volume in the pregnant woman at high vs. low altitude
  - C. The transition from intrauterine to extrauterine life: neonatal and infant oxygenation
2. Children
  - A. Aggravation of or increased risk of respiratory disease
  - B. Reascent HAPE
3. Adults
  - A. Chronic mountain sickness
4. The elderly
  - A. Migration of the elderly from high altitudes in Colorado due to disease
  - B. Increased mortality from pulmonary disease
    - 1) Aggravation of cardiovascular and pulmonary disease

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Thursday, August 10, 1995

# **PAIN MANAGEMENT IN THE WILDERNESS**

*Anne Dickison, MD*

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*Please refer to material under the same topic for Wednesday, August 9.*

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Thursday, August 10, 1995

**WILDERNESS MEDICINE  
EDUCATION: HOW TO  
REACH THE PUBLIC**

*Howard Backer, MD*

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## **Wilderness Medicine Education: How to reach the public**

Howard Backer, MD, FACEP  
Kaiser Permanente Medical Group  
Emergency Department, Hayward CA  
Sports Medicine, Walnut Creek, CA  
Past-President, Wilderness Medical Society

This will be a participatory forum involving all interested persons. Ideas and experiences will be presented and discussed. The goal is not to reach a consensus but rather to stimulate thought and exchange ideas and means of achieving a common goal. So, following this presentation:

participants will have new approaches to the vexing problem of public education,  
and have the opportunity to network with others involved in similar work.

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Thursday, August 10, 1995

# FROSTBITE

*Murray Hamlet, DVM*

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# FROSTBITE

## A. HISTORICAL ASPECTS

### 1. Napoleon

War of 1812 in Poland

### 2. The German Experience in Russia

1942 - 100,000 casualties, 15,000 amputations

### 3. George Washington

### 4. World War II

- a. 90,000 casualties
- b. Mean temp +30
- c. 7.5 million man days lost

### 5. Korea

- a. 9,000 casualties
- b. Mean temp +10

### 6. The Present Approach in Alaska

Mean temp -40°F.

## B. HOSPITALIZATION TIME - 2-6 MONTHS

## C. USARIEM EFFORT

## D. RISK FACTORS

- 1. Age
- 2. Smoking
- 3. Home of Origin
- 4. Personal perception of cold

5. Temperature and wind
6. Injury
7. Fatigue
8. Previous cold injuries
9. Race
10. Nutrition
11. Drugs
12. Duration of exposure

E. MOST LIKELY AREAS INJURED

Hands, Feet, Face

F. IDENTIFICATION OF INJURY

Grey, white, insensitive, hard, painless, grades: 1st, 2nd, 4th, arbitrary (most useful) superficial, deep

G. MECHANISM OF INJURY

1. Extra cellular ice crystal formation leaving higher concentrations of electrolytes, etc.
2. Disruption of cell membranes - from ice crystal formation.
3. Destruction of capillaries, and lining of small blood vessels.
4. Vascular stasis.
5. Necrosis.

H. NORMAL RESPONSES TO COLD

1. CIVD
2. Pain progressing to insensitivity

I. MODIFIERS OF CIVD

1. Fright
2. Hunger
3. Fatigue
4. Hypoxia



## J. TREATMENT

1. Determine if rewarming is indicated.
2. Remove constrictive clothing.
3. Rewarm the body along with the extremities.
4. Use body rewarming of hands, feet, use the arm pits or abdomen.
5. Rapid rewarming in water between 100-110°F.
6. Bandage with dry sterile gauze loosely wrapped.
7. Restrict activity (carry foot-injured patients and restrict hand use in hand patients).
8. Twice daily whirlpools for one-half hour between 90-95°.
9. Use anti-tetanus booster, forced exercise, by the patient.
10. Bivalving of circumferential eschars as they develop - allowing the whirlpool to debride.
11. Avoid early amputation - wait for self demarcation of the digits.
12. Fasciotomy is indicated (especially the feet) if deep tissue swelling and anterior compartment syndrome is evident.
13. Do not rupture the blebs.
14. Give narcotic analgesic drugs during early rewarming but afterwards, they're unnecessary.
15. Allow no tobacco.
16. Use antibiotics only as infection indicates.
17. Use thorazine or sparine for the alcoholic patient.

## K. THINGS NOT TO DO DURING TREATMENT

1. Do not rub the injury, don't massage it.
2. Don't use any creams or ointments.
3. Do not rupture blebs.
4. Do not allow the patient to smoke, or use alcohol.
5. Avoid a freeze-thaw-refreeze injury.
6. Do not rub snow on it.
7. Avoid excess heat (open fire or vehicle exhaust).

## L. PREVENTION

1. Wear clothing loose and in layers.

2. Keep them clean and dry.
3. Do not overextend yourself or the people around you.
4. Do not overwork in your clothing.
5. Stay aware of your face, hands, and toes.
6. Use the buddy system.
7. Always have mittens available.

#### **M. GOOD PROGNOSTIC SIGNS**

1. Return of sensation.
2. Large, clear blebs, extending to the end of the digits.
3. Warm tissue.
4. Red or pink color
5. Good capillary filling.
6. Increased flexibility.

#### **N. BAD PROGNOSTIC SIGNS**

1. Cold, cyanotic distal parts.
2. Lack of edema or swelling.
3. Poor capillary filling.
4. Insensitive to pin prick.
5. No blebs-distal or small blue-black blebs - fever.

#### **O. SEVERITY OF INJURY**

1. Duration of exposure.
2. Coldest temperature reached.
3. Method of treatment.
4. Added insult - refreeze, manipulation, heat.

**MURRAY P. HAMLET, D.V.M.**  
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Thursday, August 10, 1995

**EUROPEAN MOUNTAIN  
RESCUE: STATE  
OF THE ART**

*Bruno Durrer, MD*

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# **SECOND WORLD CONGRESS ON WILDERNESS MEDICINE** **Thursday, August 10, 1995, Workshop Nr. 14**

## **EUROPEAN MOUNTAIN RESCUE / STATE OF THE ART**

**IN ASSOCIATION WITH ISMM AND  
 THE INT.MEDICAL COMMISSION FOR ALPINE RESCUE (ICAR-CISA)**

	Durrer Bruno	Introduction	3 Minutes
	Wiget Urs	Emergency doctors vs. paramedics Schooling of alpine emergency doctors	9 Minutes
A	Berghold Franz	Alpine rescue in Austria Avalanche rescue	9 Minutes
CH	Dubas Frederic	Alpine rescue in Switzerland Longline rescue	9 Minutes
F	Massigny B	Alpine rescue in France Crevasse rescue	9 Minutes
I	?Carlo Vettorato	Alpine rescue in Italy Terrestrial rescue	9 Minutes
D	Thomas Alfred	Alpine rescue in Germany	4 Minutes
E	? JoseRamon Morandeira	Alpine rescue in Spain	4 Minutes
GB	?	Alpine rescue in the UK	4 Minutes
N	?	Alpine rescue in Norway	4 Minutes
S	?	Alpine rescue in Sweden	4 Minutes
	?		4 Minutes
	Durrer Bruno	Final Discussion	18 Minuten

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Thursday, August 10, 1995

**MEDICAL PROBLEMS  
OF HIGH  
ALTITUDE RESIDENTS**

*Stacy Zamudio, PhD*

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**SECOND WORLD CONGRESS ON WILDERNESS MEDICINE  
MEDICAL PROBLEMS OF HIGH ALTITUDE RESIDENTS  
Thursday, August 10, 1994 4:45-6:15 P.M.**

This workshop examines the medical problems of high altitude residents in various regions of the world, hence comparative population physiology is an important component of the workshop. The life-cycle is used as an organizational framework. Data from the USA, South America and the Himalayas are compared with respect to the health problems encountered by high-altitude residents from intrauterine life to old age.

**Following this presentation participants should be able to:**

1. Discuss the evidence for population differences in altitude-associated health problems, and whether some populations appear to be protected from altitude-associated disease.
2. Discuss how maternal adjustment to pregnancy might be altered by high-altitude residence, and how these alterations impact maternal, fetal and neonatal health.

**Medical problems of high altitude residents**

1. Overview - the evolutionary perspective
  - A. Mortality patterns by age group - Colorado, USA; the Andean region, SA; the Himalayan region.
  - B. Comparison of populations residing at high altitude
  - C. Adaptive processes
    - 1) Evidence for population differences in altitude-adaptation
2. The unborn - the juncture between an individual's adjustment to altitude and the survival of the population
  - A. Reduction in infant birth weight, increased incidence of maternal complications of pregnancy in North America, South America and among Chinese immigrants to Tibet
  - B. Normal pregnancy physiology - alterations associated with residence at high altitude
    - 1) Reduction in uterine blood flow, pelvic blood flow distribution and blood volume in the pregnant woman at high vs. low altitude: relationship to maternal and neonatal complications
    - 2) Birth defects and pregnancy loss
    - 3) Moving to high altitude during pregnancy - advisable?
    - 4) Maintenance of sea-level normal values for physiological characteristics during pregnancy is evidence of successful population adaptation
  - C. The transition from intrauterine to extra uterine life: neonatal O<sub>2</sub> transport, acute infantile mountain sickness syndrome
3. Children
  - A. Aggravation of or increased risk from respiratory disease
  - B. Growth and development
4. Adults

- A. Chronic mountain sickness
- B. Pulmonary disease
- C. Hypertension
- 5. The elderly
  - A. Aggravation of cardiovascular and pulmonary disease

**Data sources for this session/further reading:**

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Thursday, August 10, 1995

**PHYSIOLOGY OF  
ALTITUDE TRAINING FOR  
SEA-LEVEL COMPETITION**

*Bengt Kayser, MD, PhD*

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## TRAINING AT HIGH ALTITUDE

Bengt Kayser

MD PhD

Meakins-Christie Laboratories

McGill University, Montreal, Canada.

### *Aim:*

The aim of this workshop is to provide some insight into the puzzle of reality vs. myth of the effects of altitude training with regard to competitive human exercise performance. This will be done using a problem oriented and interactive approach, as well as by reviewing the literature.

### *Abstract:*

#### Altitude training:

Especially since the '68 Olympics were held in Mexico at an altitude of 2250 m exercise performance at altitude has become an important issue for athletes, as well as their coaches and medical supervisors. Altitude training camps in preparation for competitive events, either at altitude or sea level, are now regular practice. The former East-German hypobaric training center 'Kienbaum' indeed seems to have been quite successful in preparing future world champions. However, until recently, a sound scientific base for altitude training as a means of improving performance was lacking (Levine et al. 1992). Most of the earlier studies were lacking in design because of lack of control groups, too few subjects, lack of control of training intensity, or use of untrained subjects. Only in recent years serious approaches to answering specific questions concerning this problem have been made.

#### Endurance training:

The maximum intensity of whole body exercise that can be maintained is decreased at altitude. Therefore the training intensity for endurance performance of an athlete will be lower at altitude when compared to sea level (Levine et al. 1991). It seems obvious that such may have a deleterious effect possibly counteracting the desired changes in oxygen carrying capacity by the increased Hb ensuing from acclimatization. Terrados et al. (1991) studied eight competitive cyclists that trained either in a hypobaric chamber (2300 m) or at sea level for 4 weeks. They found that sea level  $\dot{V}O_2\text{max}$  and work capacity were not different between the two groups. However, at simulated altitude the chamber group showed a 33% increase in performance whereas the sea level group only increased by 14% indicating a specific effect of altitude training. They also found increased muscle capillarity and decreased glycolytic enzyme activity in the chamber group, the latter coupled to decreased levels of lactic acid accumulation at submaximal workloads. In another study Levine et al. (1991) divided 21 fit but untrained subjects in three groups. One group trained at sea level at 70% of  $\dot{V}O_2\text{max}$ , one group trained in a chamber (2500 m) at the same relative load and the third trained in the chamber at the same absolute load as compared to the sea level group. They found that all groups improved their  $\dot{V}O_2\text{max}$  by

14% regardless of training environment or intensity. However, endurance performance at sea level at 85% of  $\dot{V}O_2\text{max}$  was significantly more increased in the hypoxia group. The same group also studied two matched groups of trained runners before and after a training program (Levine et al. 1991). One group lived at 1280 m and the second at 2500 m whereas they trained together at 1280 m at the same (controlled) intensity. Contrary to the lowland subjects, the altitude subjects increased their  $\dot{V}O_2\text{max}$  by 5%, associated with an almost 30 second faster 5000 m run. They explained part of their results by the 'natural doping' effect of the altitude sojourn since these subjects had increased their blood volume by 500 ml.

#### Strength training:

There is evidence for a hypoxia mediated depressing effect on work-induced muscle hypertrophy, at least in chronic hypoxia equivalent to ~5000 m (Narici and Kayser 1995). Indeed, during prolonged stays at these altitudes or higher important loss of muscle mass may occur (Hoppeler et al. 1990). At lower altitudes this issue is not completely settled yet. The results of Mizuno et al. (1990) seem to indicate that during a 2 week stay at 2100 m loss of muscle mass does not seem to play a role. They described slight changes in muscle morphometry of the gastrocnemius and triceps brachii muscles in opposite directions and explained these findings as a result of increased respectively decreased use of these muscles due to changes in training modalities (from running to cross country skiing).

#### Sprint training:

Short distance sprinting (100, 400 and 800 m) relies almost entirely on alactic and lactic anaerobic energy sources although also aerobic energy sources become recruited with increasing distance. Maximum power output for these distances is therefore not much influenced by hypoxia, provided that muscle bulk is maintained. By contrast, the performance may be better at altitude since there is a clear advantage from decreased air resistance as shown by the world records for these distances set at the '68 Olympics in Mexico City. Whether training at altitude for sprinting performance is advantageous has not been looked at in detail. Mizuno et al. (1990) trained ten elite cross country skiers before, during and after a two week training camp at 2700 m. Their subjects were highly trained and had attained a stable  $\dot{V}O_2\text{max}$  as shown by repeated tests during the months preceding the study. They found no change in  $\dot{V}O_2\text{max}$  after the training session. However, the maximum oxygen deficit that could be contracted by the subjects was increased after the training period and this was reflected by a better short-term running performance. Measurements on muscle biopsies from the gastrocnemius and biceps brachii showed increased tissue buffer capacity possibly explaining the increased anaerobic glycolytic capacity. These results seem to indicate some positive effect of training at intermediate altitude with regard to sprinting performance.

#### Performance at sea level or altitude:

From the above data it can be inferred that training at altitude may indeed be advantageous for competing at that specific altitude. The recent results of Levine et al. (1991) show that for sea level endurance performance it may be better to live at

intermediate altitude but to train at sea level. With regard to sprinting performance and based on the results of Mizuno et al. (1990) cited above it may be interesting to investigate whether sprinting performance in highly trained sprinters would also benefit from a training camp at intermediate altitude.

*Keywords:* training, altitude, sprint, endurance, muscle, ventilation, cardiovascular

*Recommended reading:*

1. Levine, B.D., R.C. Roach and C.S. Houston. Work and training at altitude. In: Hypoxia and mountain medicine. Eds: J.R. Sutton, G. Coates and C.S. Houston. Queen City Printers, Burlington (VT), 1992, pp. 192-201.
2. Levine, B.D., J. Stray-Gundersen. A practical approach to altitude training: Where to live and train for optimal performance enhancement. *Int. J. Sports Med.*: 13, Suppl. 1, S209-S212, 1992.
3. Kayser, B. Nutrition and energetics of exercise at altitude. Theory and possible practical implications. *Sports Med.*: 17, 309-323, 1994.

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Thursday, August 10, 1995

**SURVIVAL AT  
EXTREME ALTITUDE**

*Charles Clarke, MD*

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*Material will be available at the presentation.*

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Thursday, August 10, 1995

**ADVISING PATIENTS  
WITH HEART DISEASE**

*Herbert N. Hultgren, MD*

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*Please refer to Heart Disease & High Altitude.*

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Thursday, August 10, 1995

**PREDICTING  
HIGH ALTITUDE  
PERFORMANCE/EXPEDITION  
TRAINING**

*Jean-Paul Richalet, MD*

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Workshop :

PREDICTING HIGH ALTITUDE PERFORMANCE  
EXPEDITION TRAINING

Jean-Paul Richalet

Professor of Physiology  
Faculté de Médecine  
Bobigny, Paris, France

**Objectives:**

1) Recognize that predicting performance is not an easy matter in a **multifactorial environment**:

- tolerance to hypoxia
- tolerance to cold
- psychological tolerance to stress
- physical endurance capacity
- motivation

2) Consider that, in most high altitude expeditions, the main difficulty is **HIGH ALTITUDE HYPOXIA**

3) Give much importance to **PREVENTION AND EDUCATION** in order to minimize accidents.

4) Realize that the only easy way to train for high altitude is a **slow progressive acclimatization** at the beginning of the expedition.

However, artificial pre-acclimatization is efficient but not merely feasible.

# Acute mountain sickness: risk factors

Jean-Paul Richalet

A few observations have shown that it is nearly always the same subjects who are likely to adapt to high altitude without difficulty. In other words, acute mountain sickness (AMS) occurs more frequently in people who have already suffered from this syndrome. These subjective observations may lead to the conclusion that there exist some risk factors which predispose a subject to AMS. Some authors have shown that AMS, pulmonary edema, and physical performance in high altitude could be related to the hypoxic ventilatory drive (Hu *et al.*, 1982; King and Robinson, 1972; Masuyama *et al.*, 1986; Mathew *et al.*, 1983; Moore *et al.*, 1986; Schoene *et al.*, 1984). Recently, the intensity of hypoxic ventilatory drive has been directly linked with the nervous response of chemoreceptors (Vizek *et al.*, 1987). Thus, it might be suggested that people who suffer quite severely from AMS are those who, genetically, have a poor chemoreceptor sensitivity to  $O_2$  deficiency in the blood.

In a three-year study developed in the Faculty of Medicine at Créteil, the risk factors of AMS in 128 high-altitude climbers (26 females and 102 males) were systematically scanned. Subjects were tested prior to their departure on an expedition to high altitude (6,200–8,848 m), and clinical signs of AMS were recorded during the expedition (53). A discriminant analysis was performed to assess the risk factors of AMS. Aerobic power was assessed by direct measurement of  $\dot{V}O_{2\max}$ . Ventilatory and cardiac responses to hypoxia (11.5%  $O_2$ ) were determined both at rest and during exercise (50%  $\dot{V}O_{2\max}$ ). Autonomic nervous response was evaluated by means of a cold pressor test (CPT) (Viswanathan *et al.*, 1978). Visual field and eye fundus were examined before and after the expedition. Some of the parameters obtained during this study are shown in Table 1. For more detailed results, see Richalet *et al.* (1988).



53

53 Hypoxic tests.

During the expeditions, three climbers died (two men and a woman), probably from altitude-induced physiological or psychological degradation. 37% of the men and 65% of the women suffered from severe AMS. Risk factors of AMS appeared to be: previous history of severe AMS, or headache at sea level; low ventilatory and cardiac response to hypoxia; rapid and superficial pattern of ventilation; blunted response to CPT. Endurance training and regular climbing in the Alps do not protect against AMS. Atopy and smoking do not favor its occurrence. Physical performance, evaluated by the maximal altitude reached ( $6,800 \pm 1,100$  m), is closely related to sea level  $\dot{V}O_{2\max}$  ( $50.7 \pm 7.1 \text{ ml} \cdot \text{min}^{-1} \cdot \text{kg}^{-1}$ ) (54), but not to hypoxic responses. The elite climbers ( $n = 22$ ) had a  $\dot{V}O_{2\max}$  of  $55.8 \pm 6.4 \text{ ml} \cdot \text{min}^{-1} \cdot \text{kg}^{-1}$ , lower than elite, endurance-

Table 1

Men	AMS		Elite	
	-	+	-	+
n	64	38	80	22
age	35 ± 7	36 ± 8	36 ± 8	* 32 ± 7
Max alt.e.(km)	6.8 ± 1.1	6.8 ± 1.0	6.5 ± 0.9	**** 8.0 ± 0.6
Success (%)	86 ± 12	87 ± 11	84 ± 11	**** 97 ± 6
$\dot{V}O_{2\max}$ (ml.min <sup>-1</sup> .kg <sup>-1</sup> )	50.4 ± 7.4	51.2 ± 6.7	49.3 ± 6.7	*** 55.8 ± 6.4
$\Delta HR/\Delta SO_2E$ (min <sup>-1</sup> .% <sup>-1</sup> )	-1.07 ± 0.54	* -0.86 ± 0.33	-0.96 ± 0.46	-1.10 ± 0.54
$\Delta \dot{V}E/\Delta SO_2E$ (l.min <sup>-1</sup> .kg <sup>-1</sup> )	-1.10 ± 0.73	** -0.80 ± 0.37	-0.96 ± 0.66	-1.09 ± 0.48
$\dot{V}T$ ex.h. (l)	2.7 ± 0.5	*** 2.3 ± 0.4	2.6 ± 0.5	2.6 ± 0.5

Table 1. Physiological characteristics of male climbers (n = 102).

AMS + = subjects suffering from severe AMS; AMS - = subjects suffering from light or moderate AMS; Elite + = subjects with a background of high-level climbs in the Himalayas.

Max alt.e. = maximal altitude reached during the expedition; Success = percentage of success in terms of altitude (Maximal altitude reached/Altitude of the summit × 100);  $\Delta HR/\Delta SO_2E$ ,  $\Delta \dot{V}E/\Delta SO_2E$  = cardiac and ventilatory responses to hypoxia, when exercising (E); with  $\Delta HR$  = variation in heart rate between hypoxia and normoxia;  $\Delta \dot{V}E$  = variation in total ventilation between hypoxia and normoxia divided by body weight;  $\Delta SO_2$  = variation in  $O_2$  arterial saturation between normoxia and hypoxia;  $\dot{V}T$  ex.h. = tidal volume when exercising in hypoxia; Mean ± S.D., Student test = \* p<0.05, \*\* p<0.01, \*\*\* p<0.001.

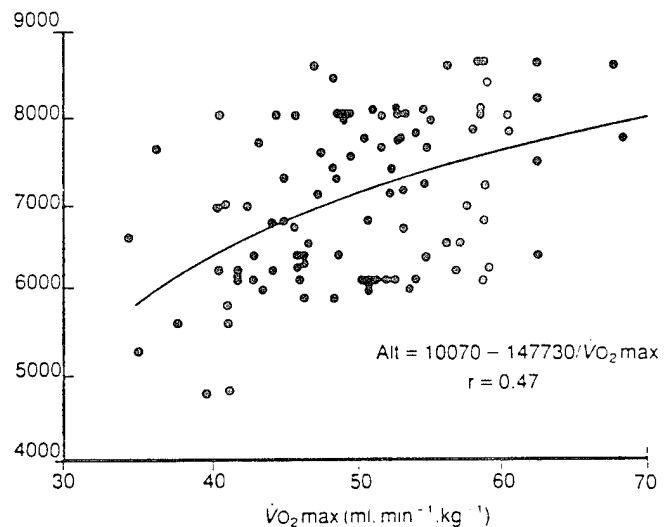
trained athletes, as already shown by Oelz *et al.* (1986). Retinal hemorrhages (found in 9% of subjects) and muscular mass loss were related to maximal altitude reached.

AMS high risk subjects could be detected by means of discriminant analysis. A history of migraine or headaches at sea level, a pattern of ventilation, and hypoxic drives seem to be the

most pertinent factors to look for, if one wants to detect susceptible subjects and warn them to make a particularly slow ascent to high altitude.

From the study, it appeared that the main determining factor for performance at high altitude was  $\dot{V}O_{2\max}$ , as shown in (Richalet *et al.*, 1987, 1988). Conversely, maximal altitude reached was not related to hypoxic drive.

54 Relation between the maximal altitude reached by the climbers and  $\dot{V}O_{2\max}$  determined at sea level before the expedition (men, n = 102, p < 0.001).



54

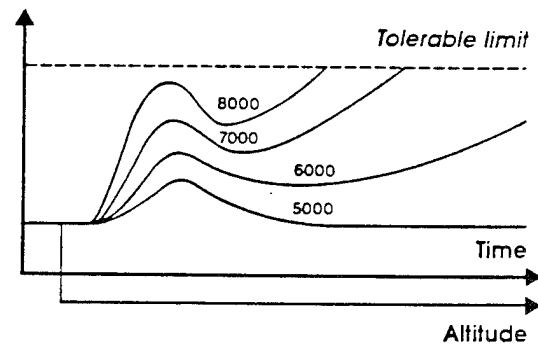
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These two main results, i.e. that occurrence of AMS is linked to hypoxic drive, and that performance in high altitude is linked to  $\dot{V}O_2\text{max}$ , are not contradictory. Both reflect the time course of acclimatization to high altitude, as shown in 55. The period of exposure to high altitude may be divided into four phases. **Phase 1** (blank phase): 0–6 hours, when no symptoms of AMS are felt. **Phase 2** (acclimatization phase): 6 hours–7 days, when all the ventilatory, renal, hematopoietic and cellular processes of acclimatization develop. **Phase 3** (phase of completed acclimatization): 7–21 days, when subjects are acclimatized and ready to perform a high level of energy expenditure in high altitude. **Phase 4** (degradation phase): more than 21 days, when the organism begins to suffer from prolonged exposure to very high altitude, resulting in weight loss, muscle mass loss, chronic dehydration, high blood viscosity, etc..

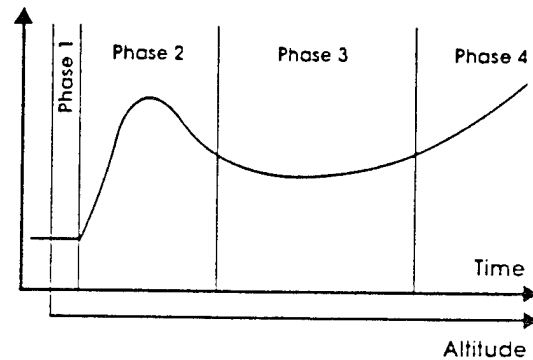
AMS mainly occurs in Phase 2, and high hypoxic drives are very important during this period, when the subject is acutely exposed to hypoxia. Performance is generally at its best in Phase 3, when AMS symptoms have usually subsided, and  $\dot{V}O_2\text{max}$  – a determining factor of aerobic, long-lasting exercise, such as is performed in high-altitude expeditions – is an important factor for those who want to climb high and quickly. A subject with a good hypoxic drive and a low  $\dot{V}O_2\text{max}$  will not suffer from AMS, but will not be able to climb very quickly above 7,000m. Inversely, a subject with a low hypoxic drive and a high  $\dot{V}O_2\text{max}$  might be very sick during the first days of acclimatization, but if he gets through this period doing little exercise and waiting for a better acclimatization, he can perform very well a few days later at high altitude.

In Phase 2, good acclimatization will result if a steady, progressive gain in altitude is respected (less than 300–500m of altitude gain per day, averaged over two consecutive days), as the major factor that induces AMS is a quick rate of ascent, whatever the climber's response to hypoxia. However, in order to climb an 8,000m peak, it is necessary to get acclimatized at a sufficiently high altitude. The optimal altitude for a base camp is 4,800–5,200m. In Phase 4, the de-

#### Signs of maladaptation



#### Signs of maladaptation



55 The four phases of physiological reaction to exposure to altitude hypoxia.

gradation will be partly avoided if the climber spends less than six nights above 6,000–6,500m, and no more than four consecutive nights. The following three 'golden rules' summarize these points:

- 'Don't go too high too fast.'
- 'Go high enough to get acclimatized.'
- 'Don't stay too high too long.'

In conclusion, high-altitude climbers do not seem to have more highly developed physiological characteristics than do average, moderately trained athletes. However, a good response to hypoxia protects against severe AMS during the first days of acclimatization, and a good  $\dot{V}O_2\text{max}$  allows a better and safer performance in very high altitude. Even if you have a good response to hypoxia, you can suffer from AMS if you don't follow the three major rules of progression in high altitude.

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Thursday, August 10, 1995

# BEING AN EXPEDITION DOCTOR

*Ken Zafren, MD*

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# BEING AN EXPEDITION DOCTOR

Ken Zafren, MD  
sometime expedition physician  
Anchorage, Alaska USA

## OBJECTIVES

Following this presentation, participants will be able to:

1. decide if they want to be expedition doctors (or other health professionals).
2. identify potential problems with expeditions and assess whether they feel comfortable as the physician (or other health professional) on a given expedition.
3. identify controversial areas of expedition medicine, such as level of preparedness, responsibilities of health care providers to expedition members, and potential legal liability.
4. define the role of the expedition and its health professionals in giving medical care to employees of the expedition and in providing care to local people not associated with the expedition.

Qualifications for the expedition physician:

1. Should be comfortable with the conditions expected on the expedition. If a full member of the expedition (e.g. climbing, caving) should be sufficiently skilled to be a member even if he or she were not a physician. If not sufficiently skilled, should probably expect to stay in base camp or less advanced camps.
2. Should be comfortable treating likely illnesses or injuries. Emergency physicians, family practitioners, and other generalists are ideal, but other specialists with appropriate training can also be effective. Psychiatric problems are much more common than generally realized.
3. Should be comfortable practicing medicine in an expedition environment with limited resources.

Assessing an expedition:

1. Are the members well known to the potential care provider?
2. Are they in good health generally? Do they have any preexisting conditions, significant medical or psychiatric history?
3. Is the goal of the expedition reasonable for the proposed team? Have members been on similar expeditions in the past? If so, did they perform well?
4. Will the members of the expedition function as a team with effective leadership?
5. Will they cooperate with the potential care provider?
6. Why do they want a doctor (other provider) along?
7. Will the physician (other provider) receive financial compensation (including a reduced price for the cost of the expedition)?

Preparing for the trip:

1. What level of medical risk are the members willing to run? What resources will be available both within the expedition (e.g. Gamow Bag, oxygen, IV fluids) and what will be the likely availability of outside rescue help? There may be financial and weight constraints which limit the ability of equipment. Who will provide the equipment and medications?
2. What preexisting medical conditions do the members have? A pre-trip screening history can be useful in anticipating problems. Pre-trip physical conditioning may be advisable.
3. What skills are represented among the other members of the expedition (e.g. EMTs, paramedics, physicians, RNs)? Should expedition members (or the provider) receive additional medical training prior to

departure and/or during the expedition?

4. What will happen in case of illness or injury? (I have even been asked what I wanted done with my body should I die on an expedition.) Plan rescue and evacuation routes and resources. Someone not on the expedition should be prepared to initiate rescue in the event that word is received of an accident or illness or if the group is overdue.

5. What legal liability is the physician (other provider) assuming? To what standard of care will he or she be held in the event of alleged malpractice?

6. Who will be responsible for medical care of non-expedition members who are employed by the expedition.

7. What preventive measures will be necessary? These include pre-travel immunizations, sunglasses, sun screens and water disinfection. Some or all of these may need to be arranged by the doctor (other provider). Also, malaria prophylaxis and safe travel practices may be necessary in tropical and less developed countries and the doctor (other provider) may need to be an educator or advisor.

Controversial areas:

1. Does the expedition have the resources to care for its (non-member) employees properly and not to endanger them unduly?

2. Does the expedition plan to provide medical care to local people in areas visited by the expedition?

3. To what extent will some expedition members treat themselves for urgent and non-urgent conditions and to what extent will they keep the physician (other provider) informed? To what extent may other members be using psycho-active substances, including alcohol and drugs (both illicit and prescribed)?

4. You are already a doctor (other provider) and are unlikely to hide this fact from other expedition members. Therefore, even if you are not the "expedition doctor" you may have certain obligations, both ethically and assumed by other members. Does it make a difference if you are not being financially compensated?

Further reading:

Many of these topics are covered in Auerbach PS *Wilderness Medicine: Management of Wilderness and Environmental Emergencies* (Third Edition) Mosby 1995, in various chapters. The physician (other provider) may wish to bring along a book for other members to read and use as a reference in case the provider becomes the patient or victim. I usually take Wilkerson JA *Medicine for Mountaineering The Mountaineers*. I am unaware of any specific references which cover the overall subject of being an expedition doctor.

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Thursday, August 10, 1995

# ARCTIC SURVIVAL

*Brian Horner*

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**LTR TRAINING SYSTEMS**  
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**SAFETY • SURVIVAL • SECURITY**

## **Second World Congress on Wilderness Medicine**

**Presenter:** Brian K. Horner, LTR Training Systems, Anchorage, Alaska

**Background** Owner/Chief Instructor, LTR Training Systems,  
Chief Survival Instructor, US Customs Service  
USAF Survival, Escape and Evasion Specialist, 13 years  
US Army, Desert Survival Instructor, 5th Group, Special Forces  
NASAR Wilderness EMT - Instructor,  
Swiftwater Rescue Technician Instructor  
NAUI Certified Scuba Instructor  
University of Alaska, Wilderness Studies Survival Instructor  
US Department of Interior, Aircraft Immersion/Survival Instructor  
Team Member, Alaska Mountain Rescue Group,  
Speaker, Tyumen Medical Conference, Nadyrn Russia, 1993  
Mt. Vaughan Antarctic Expedition 1993-1994

**Topics:** Aircrash Survival and Arctic Survival

### **Program Objectives:**

#### **I. Aircrash Survival,**

- \* Typical aircrash scenarios and the injuries that accompany them
- \* To be familiar with the dynamics of helicopter and fixed wing impact forces and how proper crash positions minimize these forces.
- \* Evacuation techniques for helicopter and fixed wing crashes
- \* Specific adaptations for airframe crashes into water environments
- \* Methods of improving crewmember and passenger psychological reactions to aircraft emergencies.

#### **II. Arctic Survival**

- \* Typical scenarios for Arctic/Antarctic emergencies
- \* Identification of Psychological and Physical factors of field stress on victims of cold weather emergencies.
- \* Calorie and fluid consumption for cold weather areas
- \* Proper equipment selection for cold weather travel
- \* Improvisational techniques for cold weather clothing and shelters in emergencies.
- \* Constructing proper survival and medical kits for cold weather field operations.

Both presentations this year will present information on how individuals and groups can adapt to emergencies and increase their chances of survival. The data will be presented using slides, videos and demonstrations that provides graphic insight into a number of emergencies that persons can encounter while traveling in "any" area of the world.



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**SAFETY • SURVIVAL • SECURITY**

**FOR IMMEDIATE RELEASE: January 19, 1995**

## **AIRLINE FATALITIES FOR 1994 CLIMBED TO FIVE-YEAR HIGH**

(Washington, DC) -- Total fatalities last year in all U.S. scheduled commercial airline accidents rose to 264 persons from 25 in 1993, while general aviation aircraft deaths declined to 706 persons from 737, according to preliminary statistics released today by the National Transportation Safety Board (NTSB).

The fatal accident rate rose for large scheduled carriers, general aviation and air taxis, but declined for commuter aircraft.

The 264 air carrier fatalities were the highest since 1988 when there were 306 deaths. General aviation's 706 fatalities were at a low. Air taxis had 64 fatalities, against 42 in 1993.

The Safety Board reported that 1,032 persons lost their lives in 1994 from 2,106 U.S. civil aviation accidents. This compared with 804 fatalities and 2,150 accidents in 1993.

Scheduled U.S. major airlines last year had 20 accidents, four of them fatal, for a total of 239 deaths, versus 22 accidents and one fatality in 1993. The 1994 fatal accident rate per million miles flown rose to 0.0008, compared with 0.0002 in 1993. Per 100,000 aircraft departures, the fatal rate was up to 0.049 from 0.013.

Scheduled commuter airline fatalities rose from 24 persons to 25 in 10 accidents in 1994, of which 3 were fatal. There were 16 accidents in 1993, including four fatal. The 1994 fatal accident rate per million aircraft miles flown declined to 0.006 from 0.008 in 1993, while that rate per 100,000 departures fell to 0.097 from 0.125 the year before. It was the third consecutive annual decline in accident rates.

General aviation aircraft accidents declined to 1,989 (392 fatal) from 2,042 in 1993 (399 fatal). The accident rate per 100,000 aircraft hours flown rose to 9.47 from 9.09 in 1993 while the fatal rate advanced to 1.87 from 1.78.

Air taxi accidents totaled 84, of which 27 were fatal, compared with 69 and 19 the year before. The total accident rate per 100,000 hours flown rose to 4.20 from 3.29 and the fatal rate advanced to 1.35 from 0.90 in 1993.

Charter airlines experienced their fifth consecutive year without a fatality. There were two accidents, compared with one in 1993. Last year's total accident rate per million miles flown was 0.0066 (vs. 0.0033 in 1993); 0.299 per 100,000 aircraft hours (vs. 0.141), and 0.570 per 100,000 departures (vs. 0.279).

Foreign aircraft had 18 accidents in the U.S., four of them fatal, resulting in 16 deaths. There were four fatal accidents and seven deaths in 1993.

The Safety Board defines an accident as an event that results in substantial damage to an aircraft or serious injury to a person.

# **Escape Considerations for Fixed Wing Aircraft**

Amphibious, float equipped and standard fixed wing aircraft present unique hazards for passengers and crew during water crashes. Accidents during the takeoff or landing phases of flight can result in the aircraft turning over and rapidly filling with water. While the crash forces are in most cases survivable, occupants of an over turned aircraft can easily become disoriented, panic stricken, and unable to remove themselves from the aircraft. Additionally, the design and operation of door latching mechanisms found on some aircraft types may inhibit the easy egress of passengers and crew members while under water.

Under such circumstances, a carefully pre-planned escape route and familiarity with the operation of emergency exits is essential. Also, additional knowledge of what causes most water accidents and hazards specific to different aircraft types should be briefed to passengers and crew. It should be noted that the 7-Steps to escaping submerged airframes taught in this manual are directly pertinent to both fixed wing and helicopter passengers.

## **Actions that most often preceded an aircraft water emergency**

- \* During a take off or landing a wing-tip strikes the water.
- \* During a take off or landing a float strikes the water.
- \* A stall occurs during take off or landing due to weather considerations, weight and balance considerations, or during turns
- \* The pilot suffers a loss of depth perception or is unable to correctly focus due to limited light or glassy water conditions.

## **General considerations for fixed wing aircraft impacts into water.**

\* If an aircraft catches a float or wing tip upon take off or landing the aircraft will immediately pivot on the surface for 180 degrees or even 360 degrees. There is also the realistic expectation of the aircraft cartwheeling across the surface of the water. This is very disorienting to the crew members, and will certainly heighten the disorientation factor even before the aircraft settles into the water.

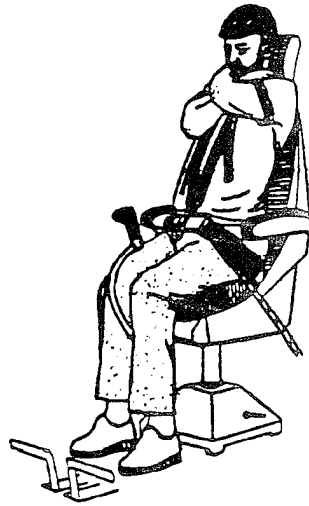
\* There is a tendency for fixed wing aircraft to sink nose first into the water due to the weight of the engine. This drives the occupants into the tail section where there are no exits as the aircraft fills with water.

\* Aircraft without retractable landing gear have a very real hazard of flipping nose first upon water contact. This can dramatically increase the impact forces to the occupants.

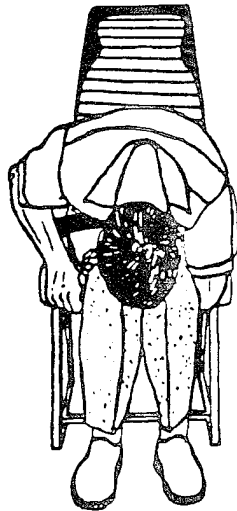
# Aircrew Crash Positions



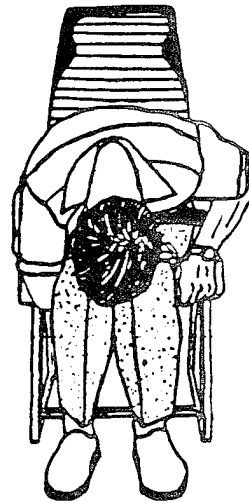
Pilot, in control



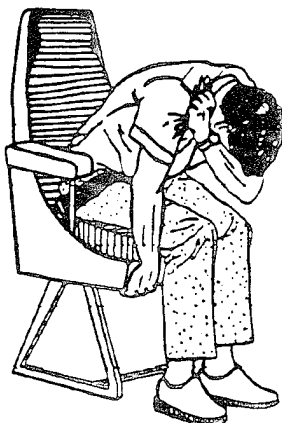
Pilot, not in control



Crew, exit right and forward



Crew, exit left and forward



Alternative Crew

## Things to Remember

1. Protect your head and neck.
2. Cover your face.
3. Toes directly under knees, lower leg at an angle.
4. Keep hold of reference point.
5. Hold position until motion stops or stabilizes.
6. Get out quickly, stay below smoke.
7. Assist others if safe to do so.
8. Treat injuries at a safe distance.

# Survival Uses For Aircraft Parts

**In an uncontrolled landing in the bush your aircraft becomes a resource you cannot ignore. Imagination is your only limitation. Use it to survive!**

- \*AILERONS - Snow cutting tools, shelter braces, splints.
- \*AIR FILTER - Fire starter, water filter.
- \*ALUMINUM SKIN - Reflector for warmth around fire, signalling device, melting pan, travel sled, snow saw blade.
- \*BATTERIES - Signalling with lights, fire starting.
- \*BRAKE FLUID, LIQUID FROM TURN/BANK INDICATOR - Fire starter.
- \*CHARTS, MAPS - Insulation when stuffed inside clothing, fire starter.
- \*COMPASS - Establishing direction for signalling, oil for fire starter.
- \*CONTROL CABLES - Shelter binding material, animal snares.
- \*CONTROL CABLES WITH PULLEYS - Block and tackle.
- \*DISK BRAKE PLATES - Signalling devices.
- \*DOORS - Sleds, shelter sides, windbreak.
- \*ENGINE COWLING - Shelter, water collection, windbreak, fire platform.
- \*ENGINE MAGS - Spark production for starting fires.
- \*ENGINE OIL AND GAS - Fire starter, fuel for stoves, black smoke for signalling.
- \*FABRIC SKIN - Fire starter, water collection, insulation.
- \*FUEL CELLS - Melt snow on black surface, fire fuel, black smoke.
- \*FUSELAGE - Shelter.
- \*HOSES - Siphoning, black smoke, binding material.
- \*INNER TUBES - Canteens, elastic binding material, black smoke.
- \*INSIDE FABRIC - Water strainer or filter, clothing and insulation, bandages.
- \*LANDING LIGHT LENS - Drinking cup, fire starter.\*LANDING LIGHTS, STROBES - Powered signals, shelter lighting.
- \*LIGHT COVERS - Utensils and small tools.
- \*MAGNESIUM WHEELS - Burn for signalling.
- \*NOSE SPINNER CONE - Bucket, stove with sand, oil and fuel, scooping tool in snow, snow melting and cooking pot.
- \*OIL FILTER - Burn for black smoke.
- \*PROPELLER - Shovel, snow cutting tool, bracing for shelter.
- \*ROTATING BEACON LENS - Drinking.
- \*RUGS AND CARPETING - Ground pad, clothing, insulation.
- \*SEATS - Sleeping cushions, back brace for spinal injuries, fire starter and signal material, ground pad, insulation, sponge rubber for neck support.
- \*SEAT BELTS - Binding material, slings, bandages.
- \*SPRING STEEL LANDING GEAR - Pry bar, cooking spit.
- \*TIRES - Fire starter and fuel, black smoke.
- \*WHEEL FAIRING - Water storage or collection, black smoke when burned.
- \*WINDOWS - Break for cutting tools.
- \*WINGS - Wind breaks, shelter supports, fire platform, signalling.
- \*WIRING - Binding material, snares.

# Personal Protective Equipment

## AVIATOR'S PROTECTIVE HELMET (FLIGHT HELMET)

Most government bureaus and agencies utilize the SPH-4 (sound protective helmet), manufactured by the Gentex Corporation. A unique feature of the helmet is that it integrates a floating suspension system that minimizes head injury from acceleration or deceleration forces.

The helmet is made in two sizes. Regular will fit hat sizes to 7 1/4 and extra-large, 7 1/4 and greater. If the helmet is exchanged with various personnel, it is suggested to purchase extra-large helmets.

To provide maximum protection, the helmet must be individually fitted and properly worn. Adjusting the helmet for proper fit is important. A loose fitting helmet is uncomfortable and can be dangerous. The helmet will stay properly positioned and provide maximum head protection during deceleration forces up to 6.0 G's.

-Before putting the helmet on, adjust the buttons or knobs on the ear cups to fit in the depression behind the ear. Ear cups should be centered over the ear and apply sufficient pressure to minimize external noise.

-The front edge of the helmet should be about 3/4-inch above the eyebrow. To raise or lower it on the head, adjust the three web straps evenly, that are attached to the crown pad. This is the floating suspension system, and should be adjusted to keep the crown pad from touching the inside liner of the helmet. Check straps by push-

ing down with a fist on the crown pad.

-The sweat band should be adjusted to fit snug and minimize head movement in the helmet.

- When wearing the helmet, attach the chin strap to the two lower snaps and pull snug.

-Tighten the nape strap in the back of the helmet so the Velcro/Nomex adjustments lay flat against the head. The nape strap minimizes the possibility of the helmet coming off in the event of the head being thrown forward.

-The visor should be in the down and locked position during takeoffs and landings.

-The microphone is noise cancelling. It should be almost touching the lips to maximize its effectiveness.

- When not in use store the flight helmet in a helmet bag.

Many lives have been saved and serious injury prevented by wearing an aviator's protective helmet. It has been proven countless times that the aviator's protective helmet saves lives! In a crash situation, it is imperative to have some type of head protection.

## FIRE RESISTANT CLOTHING

Helicopter safety and technology has improved immensely since the days of piston-driven engines. Although the turbine-engine helicopter provides increased reliability, there is still a potential for a post-crash fire. You can minimize this hazard by wearing fire resistant

clothing. Nomex (polymid or aramid) material is the current standard utilized for fire resistant clothing.

## WHAT YOU SHOULD KNOW ABOUT NOMEX

Nomex is an uncomplicated material, but it has been the subject of many questions, misconceptions, abuses, and just plain untruths. Hopefully, this article will answer any questions you may have and tell you what you should know about your Nomex clothing.

### THE MATERIAL

Nomex is a unique man-made material that is permanently fire retardant. Nomex is a registered trademark of a synthetic material developed by the Du Pont Corporation. **It is a type of nylon that will not melt and stick to the skin as other types of synthetic fibers do. Because other synthetics such as nylon and dacron melt at about 300 degrees F., they should not be worn next to the skin while flying.**

Crew members and passengers should remember that heat transfer through Nomex could be high enough to melt synthetic undergarments. **Nomex is resistant to temperature up to about 700 degrees F. and then begins to char and form a dry, brittle residue that can be brushed away when the heat source is removed.** Nomex will not support combustion as other natural and man-made materials will. For example, if a flame is placed directly on cotton, nylon, dacron, etc., the materials will burn and continue to burn when the heat source is removed.

In contrast, Nomex will char as long as the

heat source is applied directly to the fabric but will not char or burn when the heat source is taken away. Nomex will burn if contaminated with flammable substances as petroleum products or household starch.

If your Nomex does become contaminated with flammable products, simply launder or dry-clean it and the material will be restored to its original fire retardant state. At this time, there is no wear-out criteria established for Nomex. According to the U.S. Army Natick Research and Development Command, even thin Nomex provides protection.

### CLOTHING FIT

Nomex clothing was designed to be worn rather loosely to provide an airspace between the fabric and the skin. This airspace acts as insulation from heat sources. Do not alter Nomex clothing, snugly fitted Nomex negates the effectiveness of the airspace.

### STATIC ELECTRICITY

Tests for static electricity buildup were conducted at Wright-Patterson AFB on a variety of materials, including Nomex. There were no significant differences in the generation of static electricity among the materials tested.

One of the most important safety procedures in preventing an accident caused by static electricity during refueling is proper grounding of the aircraft. Another equally important safety procedure is plugging in the bonding wire from the fuel nozzle to the aircraft before the fuel cap is removed. Replace the fuel cap before unplugging the bonding wire.



If your Nomex becomes saturated with fuel, the saturated area should be thoroughly soaked in water before removal of the clothing to prevent static electricity from igniting the fuels. One crew member received first and second-degree burns when his fuel-soaked clothing was ignited by static electricity as he tried to remove them without first washing the saturated area with water.

### CLEANING

Garments of Nomex can be cleaned by home or commercial laundry or by dry-cleaning procedures without loss of their outstanding protective features. Nomex can be dry-cleaned safely without altering its fire retardant qualities. Any dry-cleaning solvent remaining in the garment is soon dissipated into the air, thus eliminating any fire hazard.

Nomex can also be laundered as many times as necessary and still be fire resistant. Since it is an easily cleaned synthetic fiber, you probably won't need a full wash cycle. Simply set the washing machine on a short cycle e.g., "delicate" or "wash and wear." Wash garments with a heavy-duty detergent such as "Tide, Cheer, All or Whisk." Pre-treat greasy stains and collar/cuff lines with a product such as "Spray 'n Wash or Shout." Do not overload home laundry equipment.

Launder garments of Nomex only with other garments of Nomex to help avoid surface entrapment of flammable lint and to minimize static in the tumble dryer. Close zippers to prevent damage and fasten the velcro to avoid picking up lint. Home hot water heaters and dryers do not get hot enough to harm the material. Remember, Nomex is high-temperature-resistant and has

even been boiled without damage. However, to conserve energy, we suggest a warm wash and cold rinse.

If Nomex is tumble dried separately from other material, an antistatic strip probably will not be required to get rid of static electricity. Tumble dry garments at a medium or high-temperature setting. Use the cool-down cycle if available; remove and hang garments as soon as tumbler stops. The rubbing together of dissimilar materials causes the buildup of static electricity. If you live in a cold, dry climate and static electricity is a nuisance, you can use a good brand of fabric softener in the was or a strip in the dryer.

Washer and dryer added softener/antistatics, although they may help reduce nuisance static and garment cling, they often reduce wickability (a comfort factor). Detergents, fabric softeners, and antistatic strips leave a residue which accumulates on Nomex. This affects the fabric's "wickability," i.e., the ability to transport water (sweat) to aid in evaporation and cooling. You can test your Nomex's "wickability" by placing a drop of water on a clean flight suit. If the water soaks in within 10 to 12 seconds, fine. If it takes 30 seconds or longer for the water to soak in, or it simply beads on the material, your Nomex needs to be dry-cleaned to remove the residue. If you have ever wondered why it is so difficult to dry yourself with a towel from a hotel or motel, it's because they use strong detergents and softeners which greatly decrease the ability to absorb water.

For maximum fire protection, greases and oils should be thoroughly removed from garments of Nomex after each wearing. If home procedures do not accomplish this, commercial laundering or dry-cleaning is

recommended. When using laundry aids, read and carefully follow the manufacturer's instructions.

## **PERSONAL PROTECTIVE EQUIPMENT**

**Personal protective equipment (PPE)** consists of, clothing and equipment that provide protection to an individual in a hazardous environment. It is required by Departmental policy that crew members and passengers will wear the following appropriate complement of PPE for pre-planned "special use" activities.

**Aviator's helmet** must provide protection for the head, ears and temple. Must provide communications for the pilot and crew members.

**Fire resistant clothing material** must be polyamid or aramid (referred to as Nomex or equivalent). The length should be sufficient to eliminate exposure between the boots and nomex clothing.

**Leather boots** which extend above the ankle. An exception would be working in an environment (water, snow) not conducive to wearing leather boots.

**Leather gloves, or nomex and leather.**

**An FAA or U.S. Coast Guard approved personal flotation device** is required to be worn on single-engine flights over water beyond power-off gliding distance to shore. Personal flotation devices will be readily available to occupants of multi-engine aircraft, single-engine float/amphibious aircraft, or float equipped helicopters when operating over water beyond gliding distance to shore.

**Anti-exposure suits** must be worn in all single-engine aircraft (readily available in multi-engine aircraft) for over water when the water temperature is estimated to be 50 degrees F. or less.

## **EQUIPMENT SOURCE LIST**

### **AVIATOR'S PROTECTIVE HELMET (SPH-4)**

Bureau of Land Management  
BIFC Dispatch Office (Fire "Replacement" Orders)  
BIFC Warehouse (other than fire orders)  
Boise Interagency Fire Center  
3905 Vista Avenue  
Boise, ID 83715  
(208) 389-2400, FTS 554-2400 Dispatch  
(208) 389-2542, FTS 554-2542  
Helmet bags can also be purchased from BIFC



Gentex Corporation (min. order of 20)  
P.O. Box 315  
Carbondale, PA 18407  
(717) 282-3550 or (800) 233-4773

# Who Survives

## Characteristics for Survivors

Although anyone can survive there are indications that some qualities and characteristics will improve a person's chances of surviving. *It is your mental attitude more than your ability to light a fire or carry out some other practical task which is most likely to ensure your ultimate survival.* For this reason it is worth considering these qualities in some detail.

### Determination

This above all has kept men alive in heat, in cold, at sea, in the air, in concentration camps and in many other situations when every fiber in their body was telling them to 'Give up'. You cannot learn determination, it cannot be taken out of a bottle. It is an amalgam of your background, upbringing at home, training at school, in a youth organization or at work and, above all, what you decide to make it.

### Self-discipline

A trait often found in both soldiers and mountaineers, is a worthwhile quality in survival. Self discipline makes people adopt a well ordered lifestyle, makes them do things now rather than later, makes them do things completely and properly rather than badly and inadequately, makes them neat and tidy rather than scruffy and unkempt.

### Self-sufficiency

Those who are able to do without the aids to modern living will probably cope a lot better.

### Outdoor living

Going into the outdoors and living in that environment on a regular basis, will provide you with the best foundation of practical skills that you could possibly want should real survival be thrust upon you.

### Confidence

In survival techniques will keep you alive for a very long time. Moreover it is the best antidote to the two great enemies of successful survival - *fear and panic*. More people die from wrong decisions taken as a result of panic than die from cold, heat, wild animals or other risks.

### Good Leadership

The survival of a group may well be helped by a leader. This may not always come from the person with badges of rank on his arm. Some of the most unlikely people only really rise to the occasion when the need for them is totally real and vital.

### Physical and mental fitness

This will help in any survival situation. It is less likely that the overweight, out of condition man or woman will cope. There is no evidence that great bodily strength is an advantage, and there is no shortage of examples of slightly built women who have proved to be magnificent survivors.

# Use of Vehicle for Shelter in Cold Conditions

Automobiles and aircraft bodies have little insulation. Without the heat source of the operating engine and heater, the interior of such vehicles soon assumes the outside air temperature.

While using an automobile or aircraft for emergency shelter in the cold has not been entirely documented, such use is not recommended. It is believed that the conductive and convective occupant heat loss is too great. There is no frictional air layering around the surface of metal vehicles. Even slight winds will remove insulative air layering from the exterior metal vehicle surfaces.



Those who have used the interior of metal vehicles for emergency shelter in the extreme cold have experienced the gamut of discomforts. Muscle cramping and restricted circulation from long periods of sitting and/or half reclining is uncomfortable, chilling and can predispose frostbite. A problem common to all who stayed in vehicles was that of condensation of moisture. During the night humidity inside increased and a layer of frost throughout accumulated. During daylight or waking hours, as activity of the occupants increased, the frost often melted. This dripped on clothing and equipment, only to freeze again at night and form solid layers of ice on clothing and other gear. When temperatures were so cold that the frost did not melt, which is frequent during the coldest winter months, the layers of frost increased. Several accounts mention build-ups of ice and frost of up to three inches in thickness. Attempts had been made to combat the frost accumulation by ventilating the vehicle, but the occupants were then troubled by penetrating cold and drifting snow.

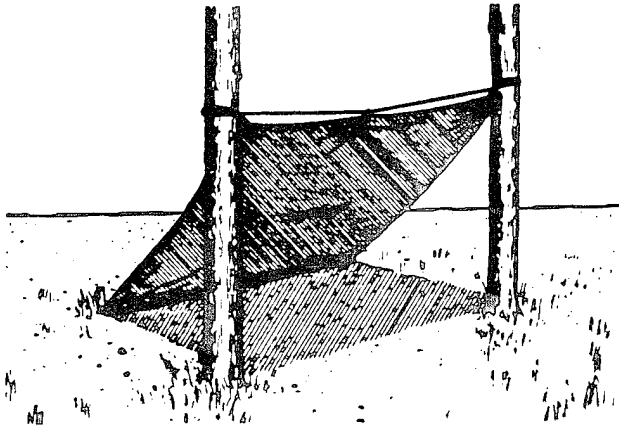
Vehicles should be considered as minimum time shelters in below freezing temperatures. A vehicle can be used as a windbreak and a dry place to sit and rest while constructing a more protective and comfortable shelter outside.

Those who have had survival training or have had considerable cold weather living experience agree that trying to use a vehicle as a shelter in below freezing temperatures can be compared to living in a refrigerator. There is also agreement that at the onset of a stalled vehicle or aircraft forced landing outside shelter building should start as soon as possible.

In situations where the vehicle engine is still operative and there is fuel remaining, a heat source from the heater will be available for warming and drying clothing. Caution should be used however, so as not to become over-heated to the point of sweating, as chilling will occur when leaving the vehicle to continue shelter building.

Special caution should be taken to assure ventilation with the engine running in a non-moving automobile. The windows should be rolled down one inch on each side to provide cross ventilation. Check the exhaust tail-pipe frequently to see that is free of drifting snow. Don't go to sleep in the car. Carbon monoxide poisoning can put an end to your shelter building and other survival efforts.

## Arctic/Temperate Shelters



**Lean-to using man-made covering**

When deciding on a shelter type for protection against the elements in arctic or temperate environments, there are three things to consider. Do I need protection from wind, cold, or rain? Is the shelter large enough to house all survivors and necessary equipment? Do I need immediate protection, is rescue imminent, and if not, will I need a more long term plan?

### Lean-to

Good protection from wind and rain. Can be constructed from natural materials. Can also be thermalized in opposing design. Easily built using minimal time and energy. Tree line environments

### A-Frame

Excellent protection from wind. Good candidate for thermal shelter due to strong structural design. Small opening good for insect protection. Tree line environments

### Snow cave

Ideal for drifted snow. Most commonly used snow shelter. Excellent thermal protection. Can accommodate multiple survivors. Easily built. Tree line or barren environments

### Snow trench

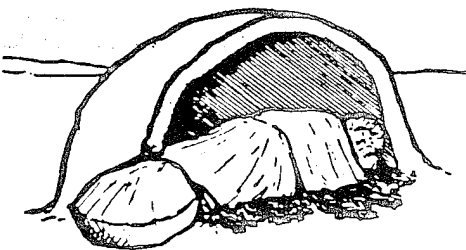
Ideal for wind packed snow at least 8 inches deep. Snow saw required. Good for individual survivors. Excellent thermal shelter for barren snow areas. Barren, wind-swept environments

### Molded dome

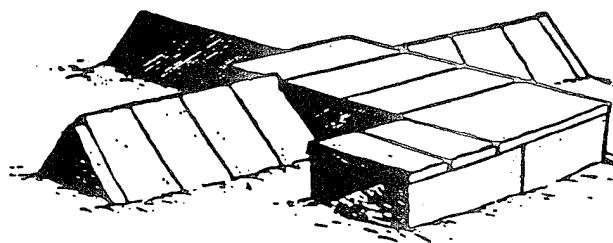
Used when snow is not wind packed or not deep enough for snow cave construction. Size dependent on snow amounts. Excellent thermal shelter. Tree line and barren environments

### Fan shelter

Used primarily for insect protection, can be thermalized. Size dependent on available materials. Easily constructed. Tree line environments



**Molded Dome**



**Multi-man Snow Trench**

# Survival Kit Recommendations

The decision to build a survival kit is a very personal one, and many things must be considered. It is impossible to include every item that may be needed in a survival situation and compromises will have to be made. The following is a list of items and ideas that may help you. By including a few items from each of the specific areas you will be well on your way to having the essentials to help yourself and others when an emergency arises.

Remember, this is a suggested list and should only be used as a guide. Attempt to keep the survival kit to a workable size and designed for "ease of carry." Periodically check the kit contents for serviceability and replace any items that have a limited shelf-life.

## SHELTER...

1. Large plastic garbage bags / tube tent.
2. Thermos, foil blanket / space blanket.
3. Rain suit (Jackets and pants).
4. Plastic sheet (6' \* 6', black).
5. Extra wool socks and hat.
6. Small wool blanket.
7. Parachute cord or strong twine (40 feet).

## FIRE AND LIGHT...

1. Matches (water or wind proof).
2. Butane or "Bic" lighters.
3. Flint striker or pyrophoric metal.
4. Cotton balls - vaselined.
5. Steel wool.
6. Sterno canned fuel.
7. Gauze bandage dipped in melted paraffin wax.
8. Candles - stick type, not canned.
9. Cyalume chemical light stick.
10. Flashlight with extra batteries (one equipped with a magnet).
11. Aluminum foil - fire platform and light reflector.

## FOOD AND WATER...

1. Chocolate bars, baking chocolate and hard candies.
2. "Ramen" noodles or minute rice.
3. Beef stick or "Slim Jims" - a fat source.
4. Instant cocoa and "cup-of-soup" packages.
5. Powdered bouillon, coffees and teas.
6. Freeze-dried camping meals.
7. Water purification tablets - Halazone or Iodine.
8. Zip-lock freezer bags - water and food containers.
9. Cook pot or coffee can.

## SIGNALLING...

1. Signal mirror - high quality.
2. Colored cloth or scarf - 4' \* 4', orange or yellow.
3. Hand held flares.
4. Parachute and sky flares - pen guns, rifle flares.
5. Smoke flares.
6. Fluorescent water dyes.
7. Battery powered ELTs and strobe lights.

## MEDICAL...

1. Ace-bandage - 3" wide.
2. Compresses - at least two for bleeding.
3. Triangular bandage.
4. Assorted band-aids - about 10.
5. Scissors or single edge razor blades.
6. Aspirin tablets.
7. Disinfectant, alcohol, peroxide or similar germ killer.
8. Insect repellent - a must in Alaska!
9. Personal items include feminine hygiene devices, hemorrhoid cream, vitamins, salt tablets etc.

## TOOLS...

1. High quality pocket or Swiss Army knife.
2. Flexible wire saw.
3. Wire cutters or hack saw blade.
4. Needle-nose pliers.
5. Emergency rations can opener.
6. Cable snares or small gauge wire.
7. Monofilament fish line.
8. Fish hooks, treble hooks and snagging hooks.
9. Fishing gill net.
10. Aluminum foil - a heavy gauge.
11. Mouse traps (YES, I'm serious!).
12. Garden trowel or camping shovel.
13. Magnetic compass.

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Thursday, August 10, 1995

# **WILDERNESS WOUND MANAGEMENT**

*Mel Otten, MD*

## WILDERNESS WOUND MANAGEMENT

Edward J. Otten, MD

Professor of Emergency Medicine

University of Cincinnati

### Objectives:

At the end of this lecture the participant should:

1. Understand the special problems associated with wound contamination in the wilderness.
2. Know the principles of wound care including clinical examination, anesthesia, debridement, irrigation and cleansing.
3. Know the types of wound closure available and the advantages and disadvantages of each,
4. Understand the controversies associated with the use of antibiotic prophylaxis for wounds.
5. Know how to manage foreign bodies, bites, punctures, and burns.



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Friday, August 11, 1995

# LAND NAVIGATION FOR SEARCH & RESCUE

*Mountain Rescue Aspen*

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## **Land Navigation for Search and Rescue**

### **Mountain Rescue - Aspen**

Following this presentation, participants will be able to navigate in a wilderness environment using a map, compass, altimeter and GPS (Global Positioning System).

- I. Basics of the Map
  - A. Lat/Longitude
  - B. True, Magnetic & Grid North
  - C. Declination
  - D. Map symbols
  - E. Revisions
- II. Basics of the Compass
  - A. Parts of the compass and how they work
    - 1. orienteering lines
    - 2. orienteering arrow
    - 3. preset declination
    - 4. magnetic needle
    - 5. slope meter
    - 6. index line
- III. Basics of GPS
  - A. How a GPS works
  - B. Parts of a GPS
  - C. Field applications in mountain rescue and backcountry navigation
    - 1. Determining Lat/Longitude
    - 2. Using "Over and Up"
- IV. Navigation with Map and Compass
  - A. Taking a map bearing
  - B. Following a map bearing in the field
  - C. Taking a field bearing, and plotting it on a map to determine:
    - 1. where you are using triangulation
    - 2. what is "that" in the field that you are looking at
- V. Special Applications
  - A. Use of an altimeter
  - B. Travel techniques
    - 1. Leap frog
    - 2. Aiming off
  - C. Determining directions without the help of a map or compass
    - 1. Wristwatch
    - 2. 3 sticks

## RULES:

- 1) D.O.T. arrow points to the direction you're going or looking
- 2) The orienteering arrow points North on the map
- 3) Magnetic needle always points to your declination (Rovers age)

or

If you are using a compass with the ability to preset your declination, then the magnetic needle always is aligned with the orienteering arrow/chevron (Put Rover in the Dog House)

- 4) The orienteering lines of compass must be parallel with the meridian lines of your map.

A map bearing is any angle going clockwise from 0 degrees (North), 90 degrees (East), 180 degrees (South), 270 degrees (West), and back to (North) 360 degrees.

"Rover" is your magnetic needle

"Rovers Age" is the declination

"Rovers Dog House" is the orienteering arrow

**DETERMINING A MAP BEARING-using your compass as a protactor** Goal: To find the "bearing" from your known point to a specific destination.

- 1) Draw a line from point A to point B
- 2) Lay the base plate of the compass along the A-B line
- 3) Rotate compass housing until the orienteering lines are equal to the meridian lines
- 4) "Read Bearing Here"

## **FOLLOWING A BEARING-IN THE FIELD**

Goal: To follow a bearing from your known point to a specific destination

- 1) Dial in the bearing at the index line
- 2) Hold compass at waist level
- 3) Rotate your body until the magnetic needle=declination (point magnetic needle to Rovers age) or put Rover in the dog house
- 4) Follow D.O.T. arrow

## **TAKING A FIELD BEARING**

Goal: To determine what Peak, Lake, or other unknown point is in the distance (part 1) This is also used for Triangulation.

- 1) Point the D.O.T. at the object, (mountain, lake, etc.)
- 2) Rotate housing until the magnetic needle=declination (point magnetic needle to Rovers age) or put Rover in the dog house
- 3) "Read bearing here"

## **PLOTTING A FIELD BEARING ON THE MAP**

Goal: To determine what Peak, Lake or other unknown point is in the distance (part 2)

- 1) Dial in the bearing at the index line
- 2) Lay base plate on the map at the known point
- 3) Rotate the compass (from known point) until the orienteering lines=meridian lines

## **TRIANGULATION**

Goal: To determine your location on the map. Note: you must first take a field bearing from a known field point, then plot it on the map.

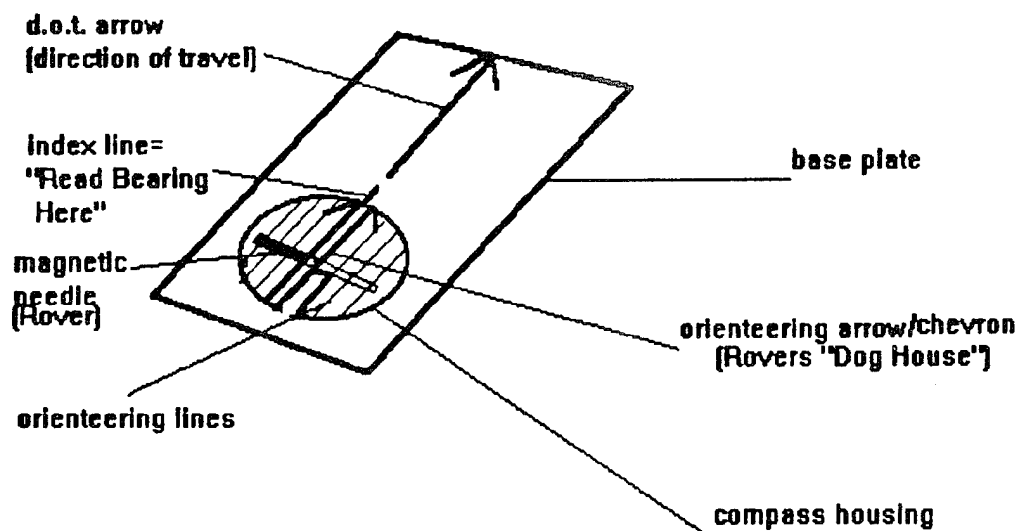
- 1) Take two or more "field bearings" (try to make these at 90 degrees to each other)
- 2) Plot the field bearings on the map
- 3) Where field bearings intersect should be your location.

## **ORIENTING YOUR MAP TO NORTH**

Goal: To align your map in the field so it is oriented to the real world

- 1) Dial in a bearing of 0 or 360 on your compass
- 2) Lay the base plate of your compass on the edge of your map (meridian line)
- 3) Rotate map and compass together until the magnetic needle=declination (point magnetic needle to Rovers age) or put Rover in the Dog house.
- 4) Top of map is now pointing to TRUE north.

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Friday, August 11, 1995

# LAND NAVIGATION FOR SEARCH & RESCUE

*Mel Otten, MD*

# MAP AND COMPASS

Edward J. Otten , MD Professor of Emergency  
Medicine and Pediatrics, Director , Division of Toxicology  
University of Cincinnati College of Medicine

Following this lecture the participant will be able to read and understand a topographic map, understand the use of a compass and be able to find direction by using a map and compass.

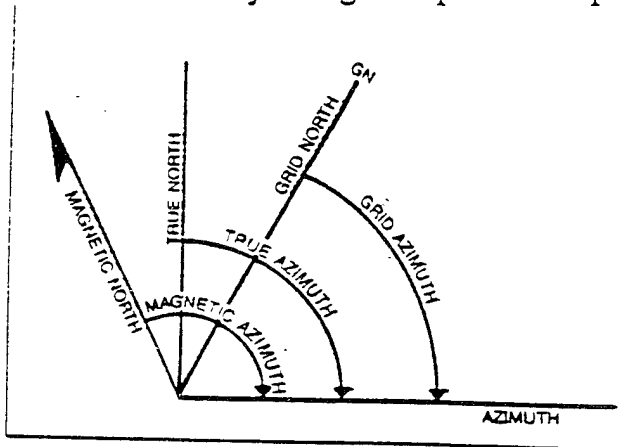


Figure 1. True, Grid, and Magnetic Azimuths

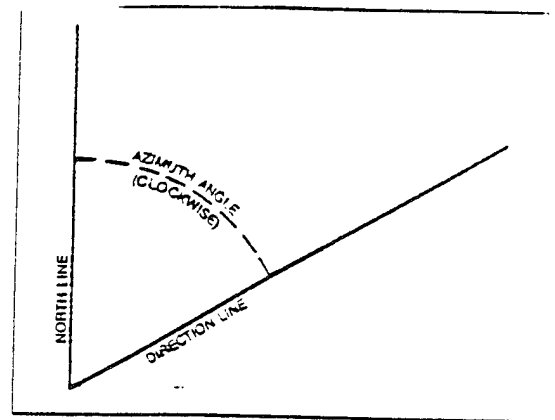


Figure 2. Azimuth Angle

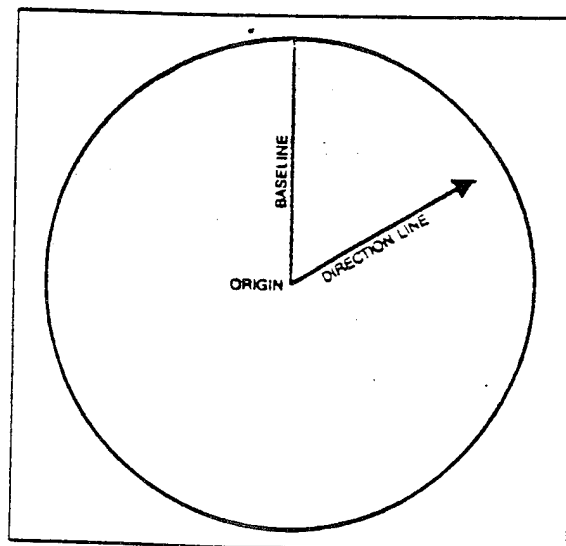


Figure 3. Origin of Azimuth Circle

## Symbols

Most topographical maps are multicolored, and each color has a special meaning. In general, black is used to show man-made features: railroads, buildings, trails, boundaries, location names. Blue indicates water: streams, marshes, lakes. Green areas are covered with forests or shrubs, while white stands for the open country of meadows, talus slopes, beaches, and alpine tundra. Red is reserved for improved roads and for grid lines and numbers that, when used with a compass, can improve the accuracy of your navigating.

### MEANING OF MAP COLORS

Green	Major vegetation (forest, brush, orchard)
Blue	Water (lake, stream, spring, marsh, water tank)
Red	Highways or boundaries
Black	Man-made structures and place names (buildings, roads, trails, bridges, railroads)
White	Absence of major vegetation, (prairie, meadow, tundra—above timberline)
Brown	Contour lines and standard elevations

### TOPOGRAPHIC MAP SYMBOLS

Primary highway		Power transmission line	
Secondary highway		Landmark line	
Light-duty road			
Unimproved road		Dam with lock	
Trail		Canal with lock	
Railroad: single track		Large dam	
Railroad: multiple track		Small dam	
Bridge		Buildings	
Drawbridge		School—church	
Tunnel		(barn, warehouse,)	
Footbridge		Tanks	
Overpass—Underpass		Wells	

U.S. mineral prospect		Horizontal control station	
Quarry—Gravel pit		Vertical control station	
Mine shaft		Road fork	
Campsite—Picnic area		Checked spot elevation	
Landmark—Windmill		Unchecked spot elevation	
Exposed wreck			
Rock or coral reef			
Foreshore flat			
Rock: bare or awash			

Index contour		Intermediate contour	
Supplementary cont.		Depression contours	
Cut—Fill		Levee	
Mine dump		Large wash	
Dune area		Tailings pond	
Sand area		Distorted surface	
Tailings		Gravel beach	
Glacier		Intermittent streams	
Perennial streams		Aqueduct tunnel	
Water well—Spring		Falls	
Rapids		Intermittent lake	
Channel		Small wash	
Sounding—Depth curve		Marsh (swamp)	
Dry lake bed		Land subject to controlled inundation	
Woodland		Mangrove	
Submerged marsh		Scrub	
Orchard		Wooded marsh	
Vineyard		Bldg. omission area	

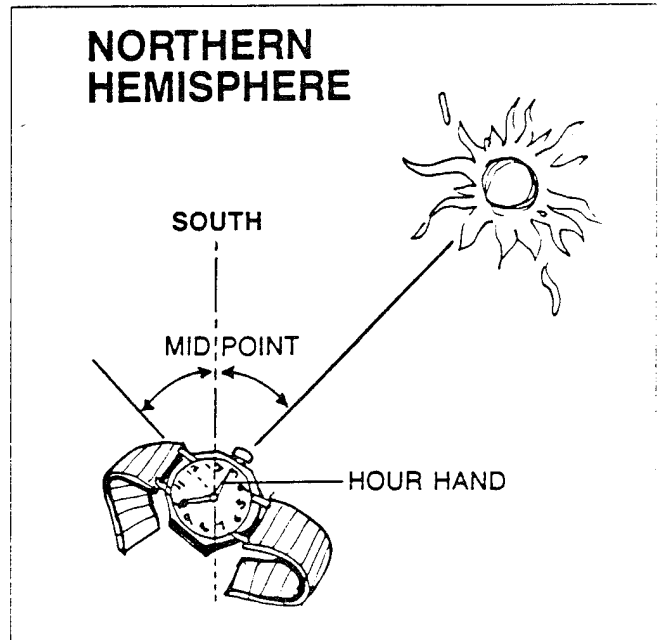
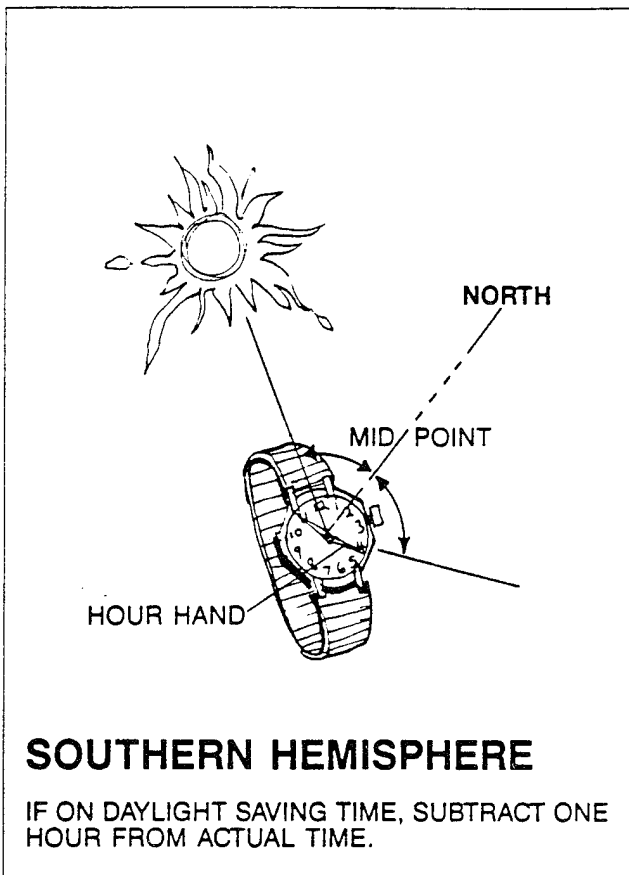


Figure 13. Using a Watch to Determine Direction

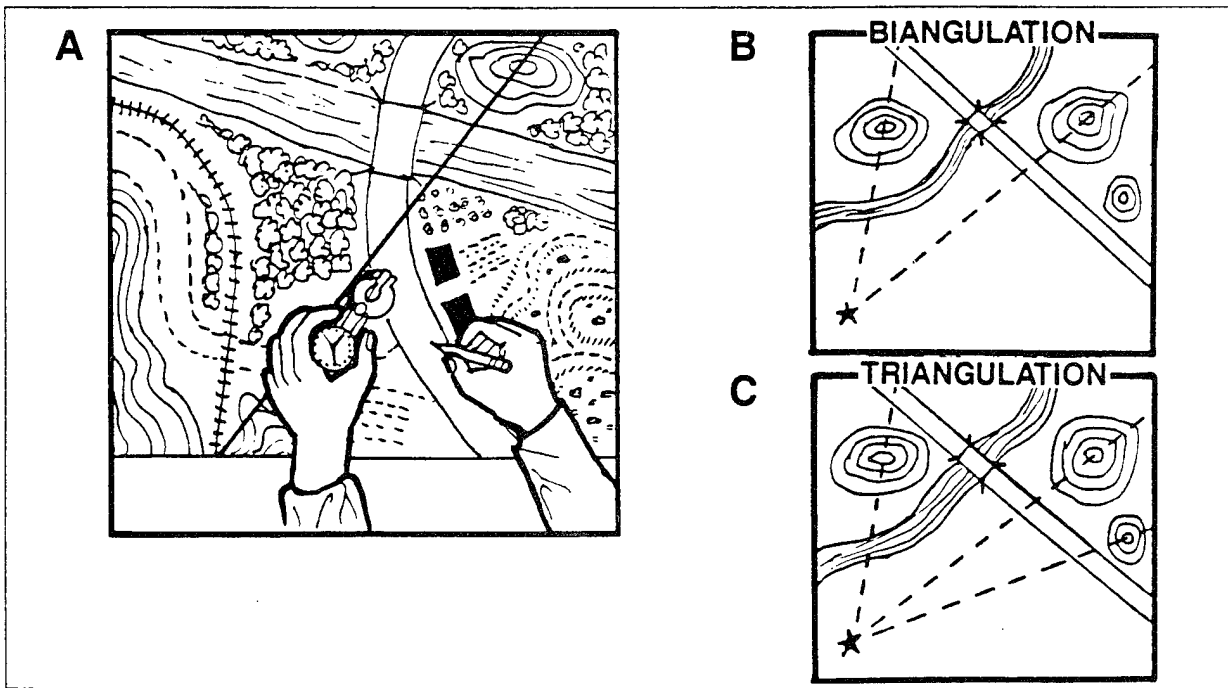


Figure 14. Using Map and Compass



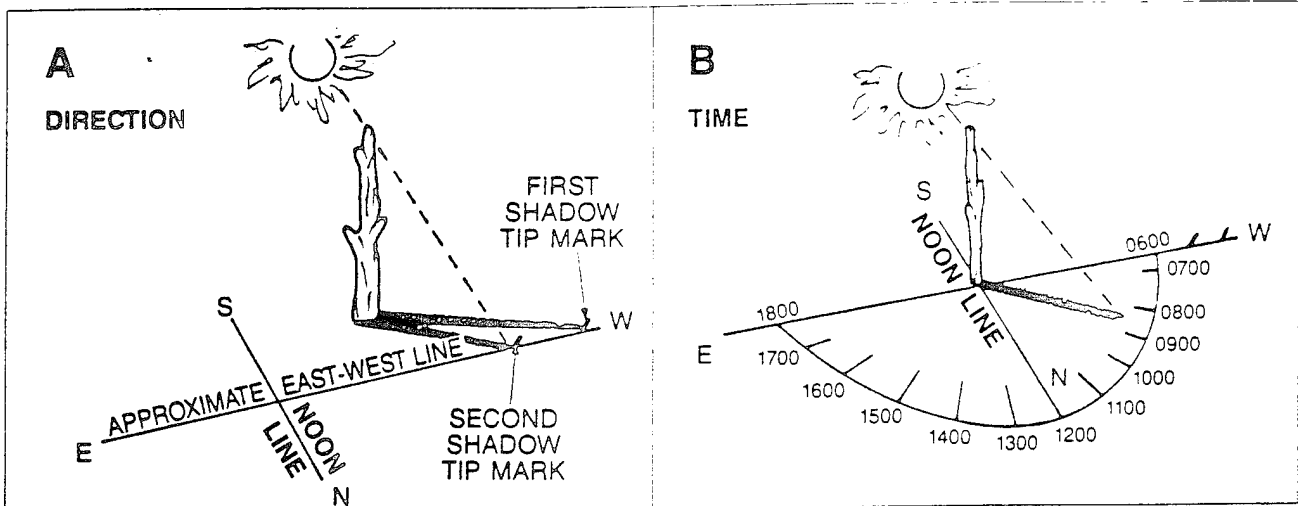


Figure 10. Determining Direction and Time by the Sun

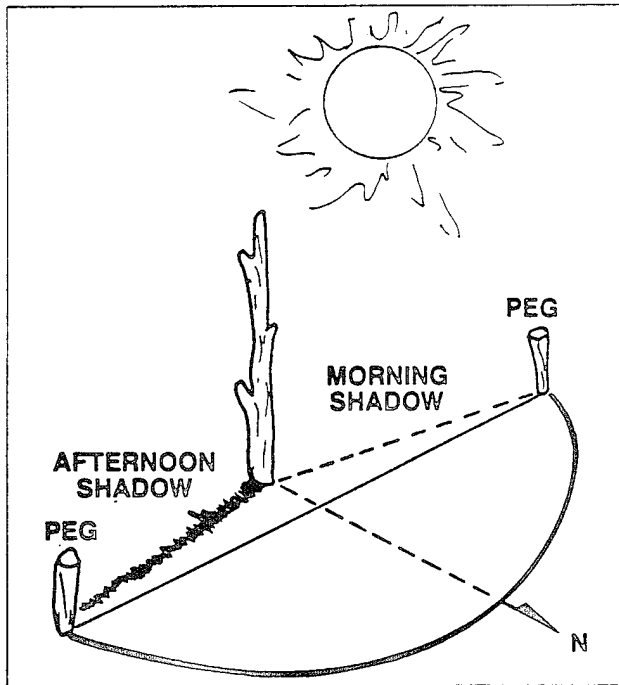


Figure 11. Equal-Shadow Method of Determining Direction

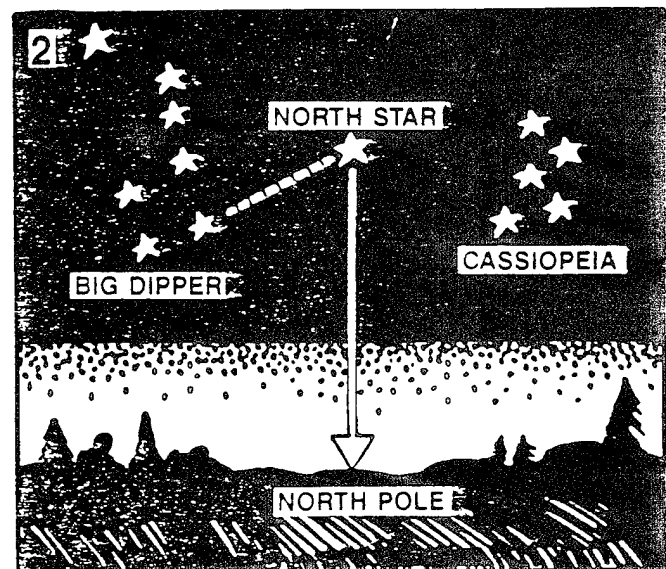
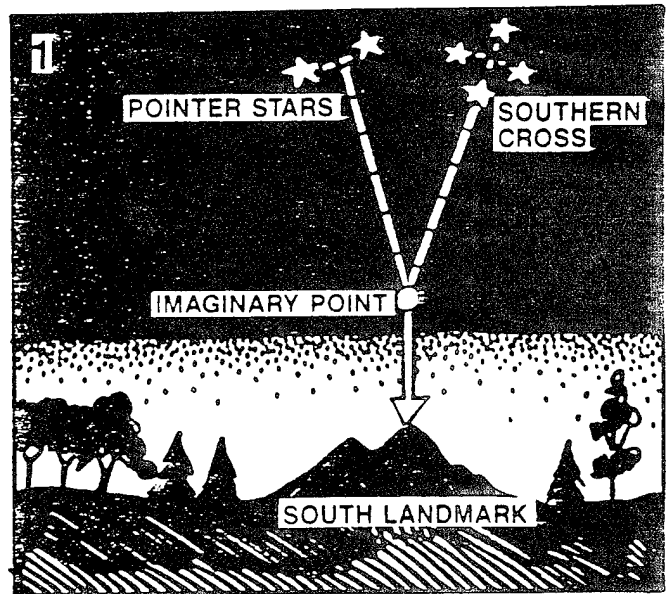


Figure 12. Using the Stars

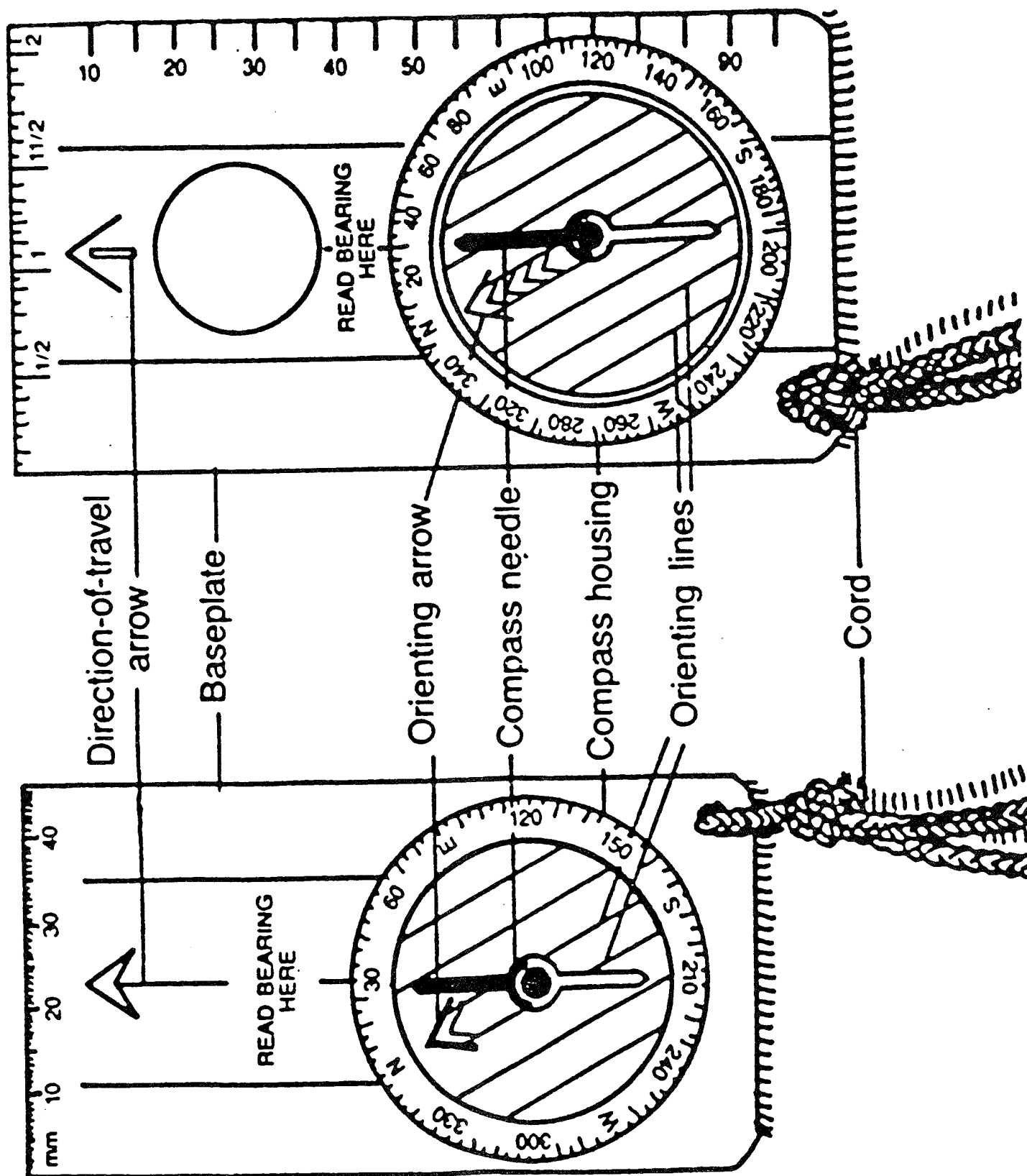


Figure 4. Lensatic Compass

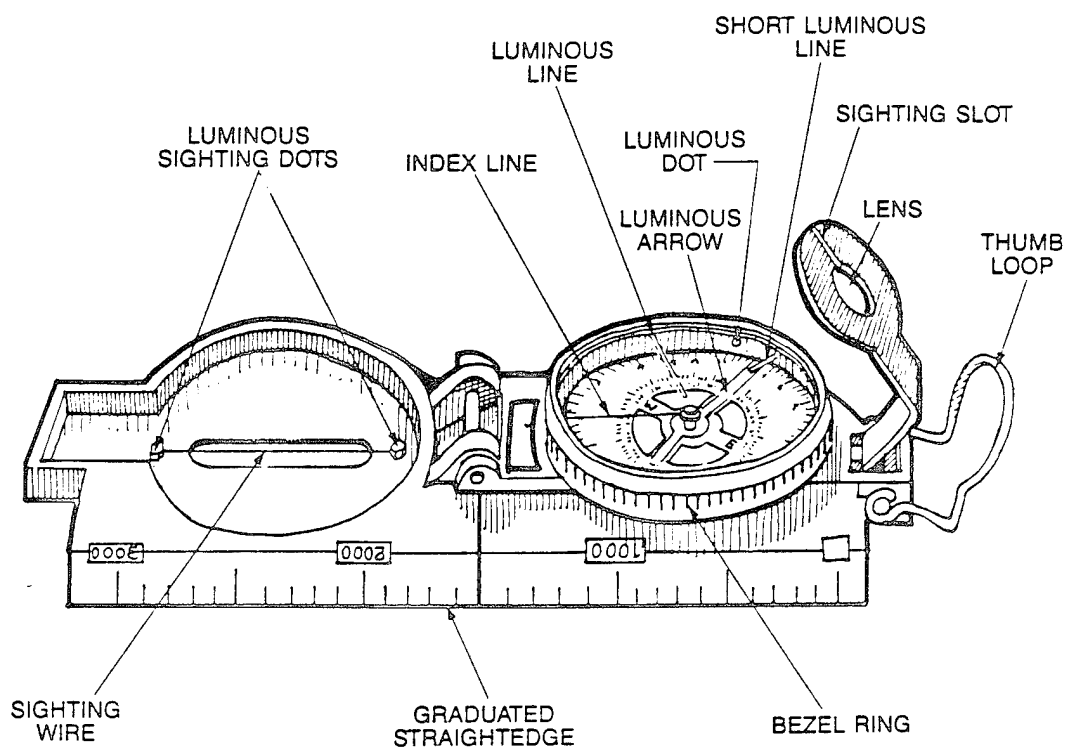
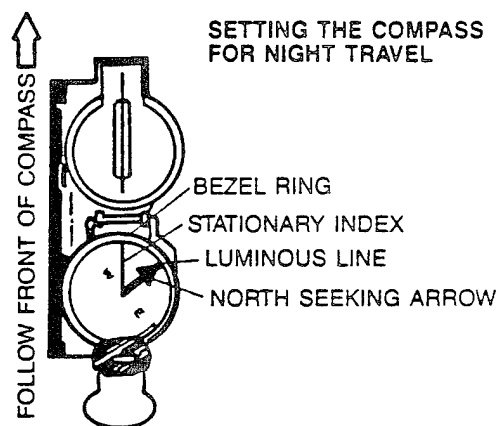


Figure 5. Holding the Compass



Figure 6. Setting Compass for Night Travel



Each click of the bezel ring equals 3 degrees.

Heading between 0 and 180 degrees is divided by 3. Sum is number of clicks to the left of stationary index line. Heading between 180 and 360 degrees, subtract heading from 360 then divide sum by 3. New sum is the number of clicks to the right from stationary index line.

Examples

Heading of  $027^{\circ}$  = 9 clicks left

Heading of  $300^{\circ}$  = 20 clicks right

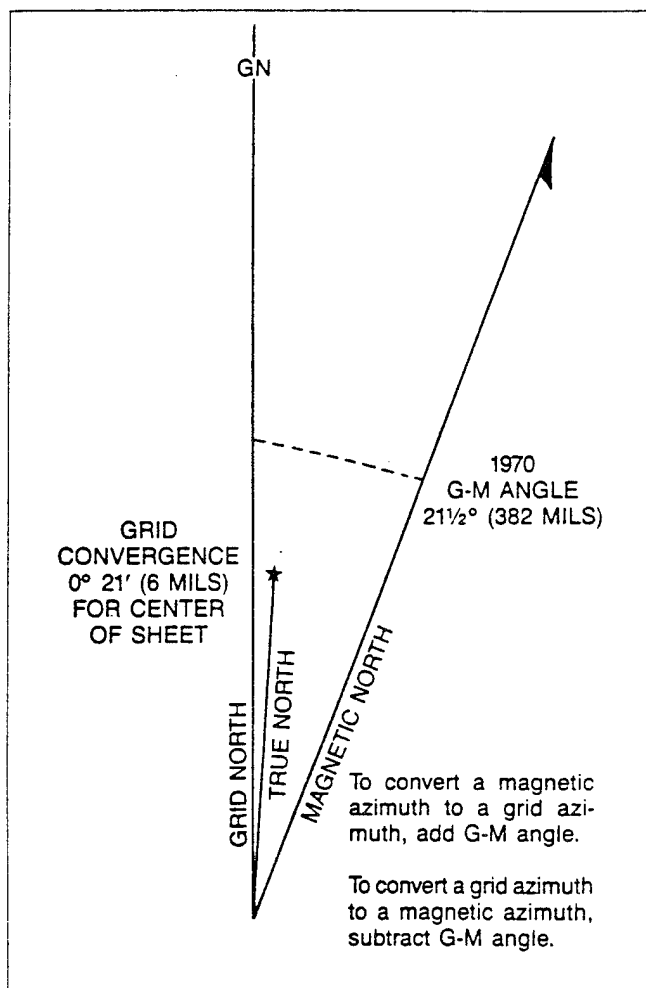


Figure 7. Magnetic North

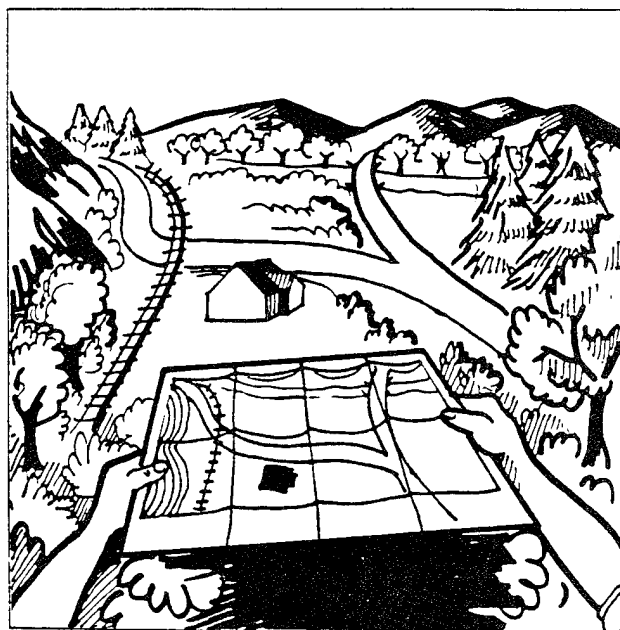


Figure 9. Orienting a Map

Figure 8-A

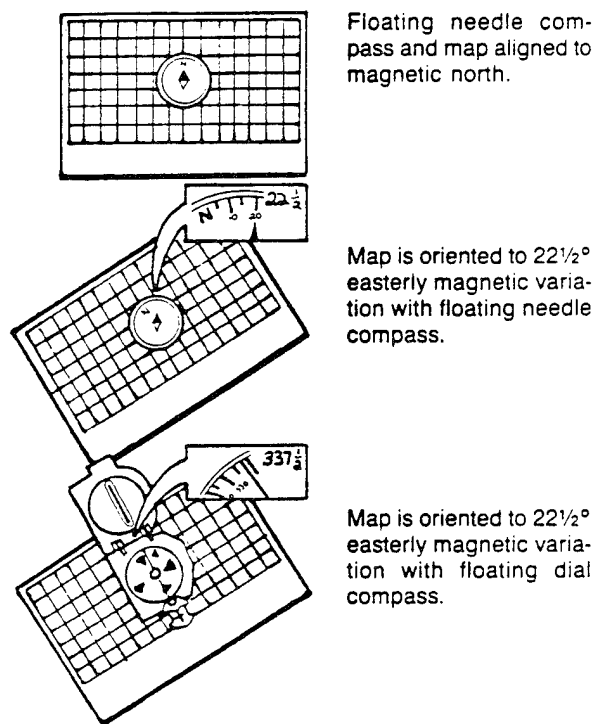


Figure 8-B

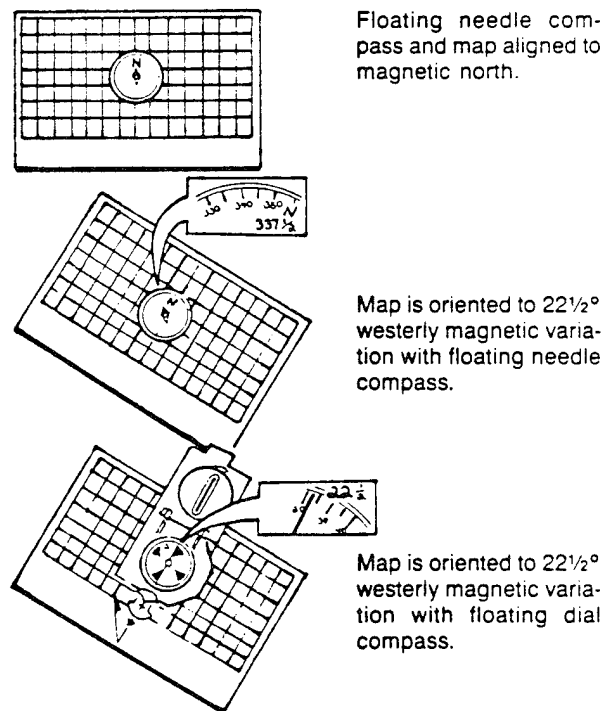


Figure 8. Floating Needle Compass

## ORIENTING A MAP TO THE TERRAIN

1. Line up the orienting arrow with  $0^{\circ}$  Azimuth on your compass.
2. Line up the edge of the compass with the magnetic north line on the declination diagram.
3. Rotate the compass and map as a unit until the compass needle is aligned with the orienting arrow.
4. The map and the actual terrain are now oriented (see fig. 9)

## FOLLOWING AN AZIMUTH (map to terrain)

1. Line up the compass with a line connecting your point of origin to your destination.
2. Rotate the compass orienting arrow until it lines up with the magnetic north line in the declination diagram.
3. Pointing the direction of travel arrow away from you turn your body until the compass needle aligns with the orienting arrow.
4. Align the direction of travel arrow with a landmark and walk towards that landmark. Once that landmark has been arrived at choose another along your direction of travel until you arrive at your destination.

## Finding your location (terrain to map)

1. Point the direction of travel arrow at a prominent landmark in the terrain.
2. Rotate the compass housing until the needle aligns with the orienting arrow. You have just shot an azimuth or taken a bearing on that landmark.
3. Place the edge of the compass on the symbol for the landmark on your map. Rotate the compass on that point until the orienting arrow aligns with the magnetic north line in the declination diagram.
4. Draw a line along the baseplate of the compass.
5. Repeat the process with another landmark or two. Where the lines intersect is where you are.

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Friday, August 11, 1995

# **IMPROVISED AIRWAY MANAGEMENT**

*Anne Dickison, MD*

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# **IMPROVISATIONAL AIRWAY MANAGEMENT**

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## **Learning Objectives:**

Following this presentation, participants will be able to recognize the signs and symptoms of significant upper airway obstruction, understand the basics of upper airway anatomy, and be able to utilize such non-invasive airway maneuvers as appropriate positioning, cricoid pressure, the Heimlich maneuver, the head-tilt/chin-lift, and the jaw thrust. The principles of nasal packing, cricothyrotomy, and the placement of oropharyngeal and nasopharyngeal artificial airways will be reviewed prior to a discussion of ideas for temporizing improvisational substitutes for these life-saving airway adjuncts.



## Second World Congress Wilderness Medical Society

### IMPROVISATIONAL AIRWAY MANAGEMENT

#### Causes of Airway Emergencies in the Remote Setting

- Maxillofacial trauma
- Unconsciousness
- Anaphylaxis with laryngospasm or bronchospasm
- Aspiration of foreign bodies
- Neck trauma resulting in extrinsic compression
- Neck trauma with penetration or disruption of the airway
- Chest trauma with resultant pulmonary edema or hemorrhage

#### Rapid Airway Assessment: Physical Diagnosis

Is the patient pale or cyanotic?

If conscious and unrestrained, what position is the patient assuming?

Is there a voice with vocal effort? Is it normal?

Are there retractions with respiratory effort?

If there is no respiratory effort, does the chest rise with positive pressure ventilation?

Will a jaw thrust or chin lift maneuver or tongue retraction improve chest rise in the obtunded patient?

Can the patient open his mouth and stick out his tongue?

Is there deformity or swelling of the neck? Any tracheal deviation?

Does the larynx move appropriately when the patient swallows?

Is there subcutaneous emphysema?

Can air be heard entering the chest? Are breath sounds bilaterally clear and equal? Is the chest rise symmetric?

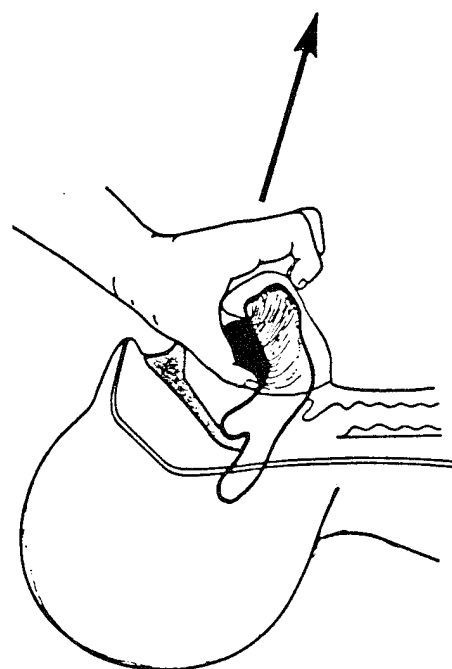
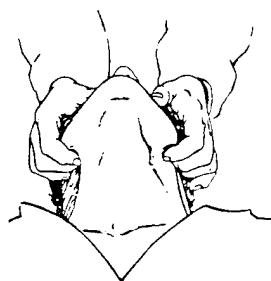
If there is sputum, is it bloody? Has the victim vomited blood?

What does the cough sound like? Is it forceful? weak? congested? gurgling?

If there is profuse head or neck bleeding, can you roughly identify its source?

Are the teeth loose or traumatized?

## Obtunded Patient with Upper Airway Obstruction



Jaw Thrust  
Tongue Retraction  
Chin Retraction  
Neck Positioning

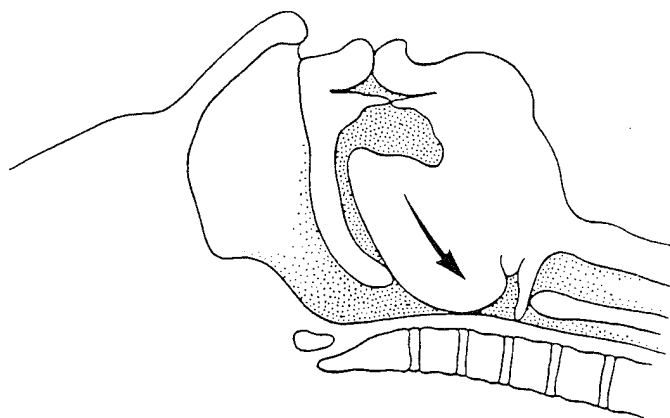
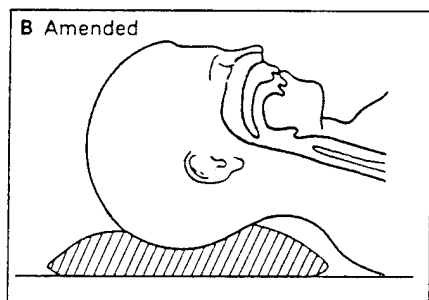
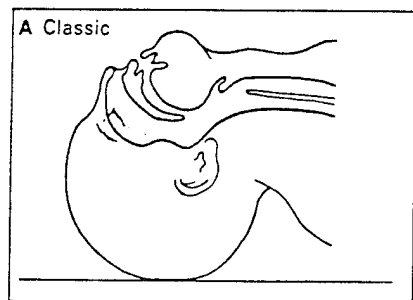
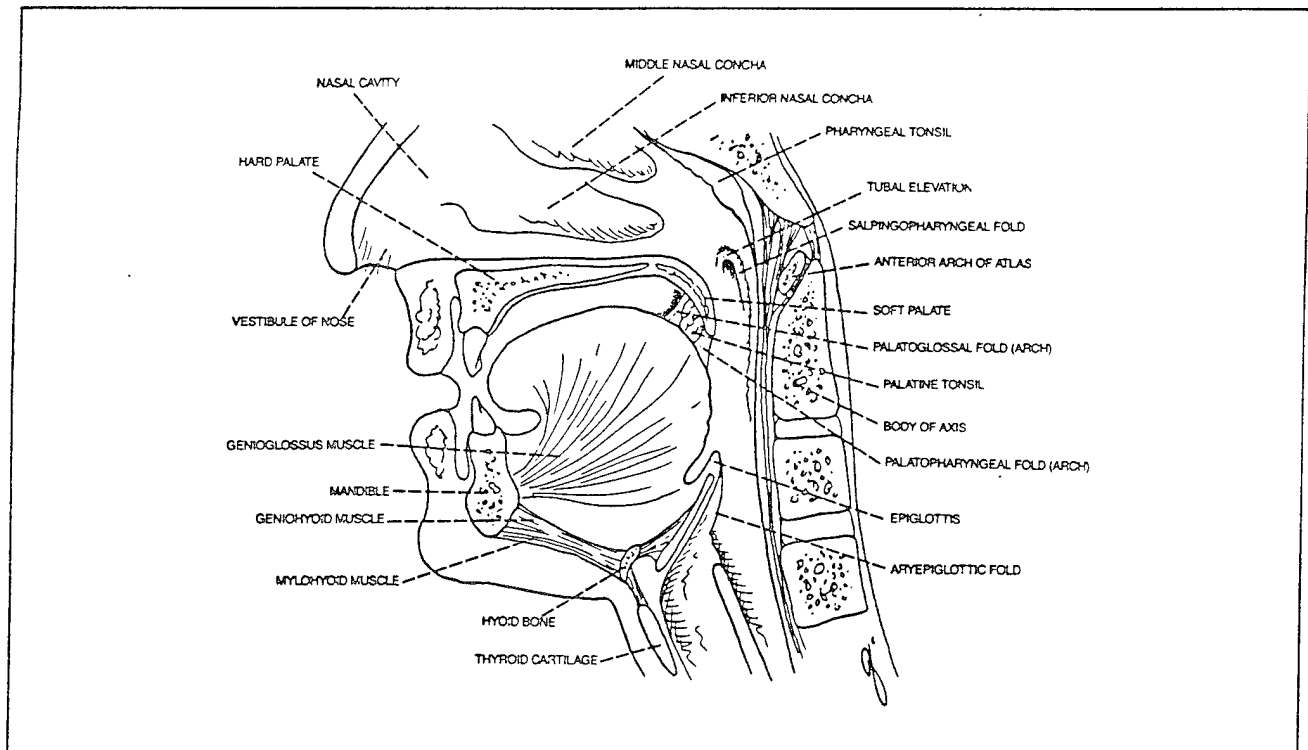
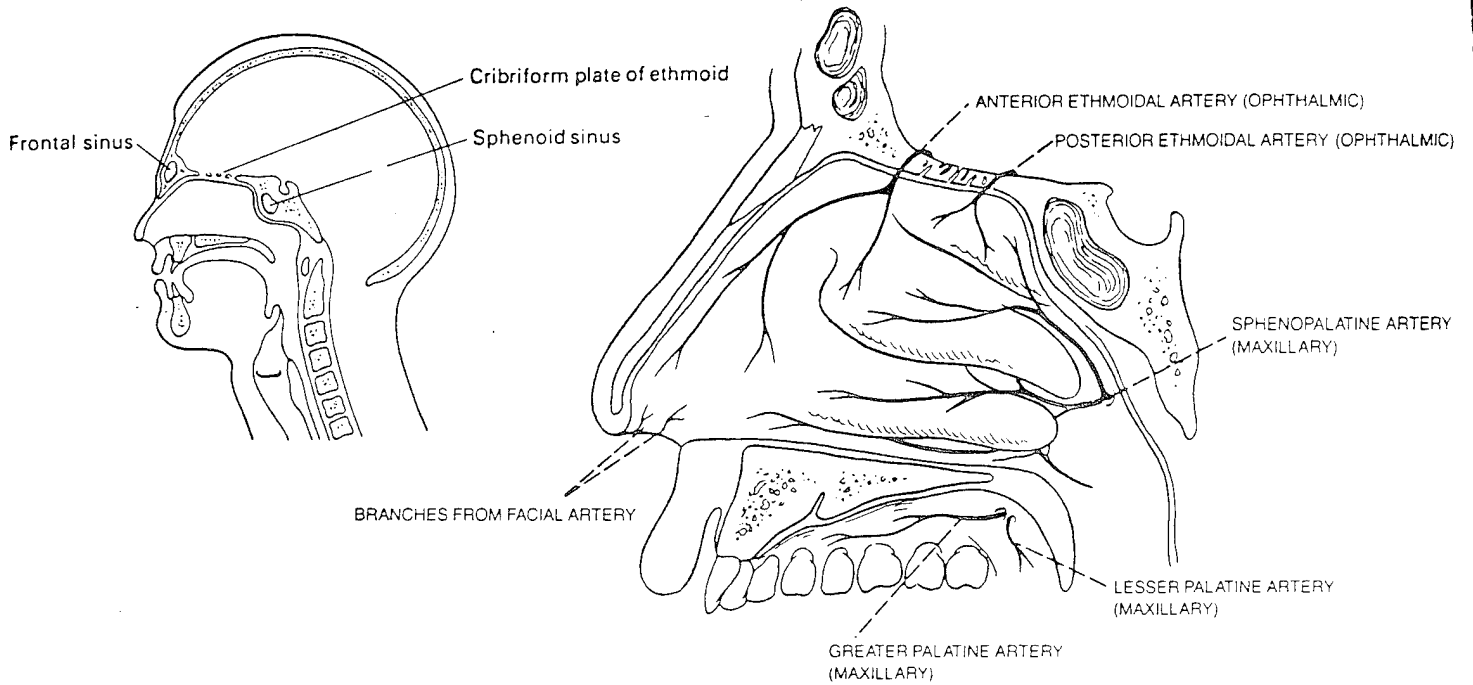


Figure 2-2. Tongue position in the unconscious, supine adult.

## Nasopharyngeal Anatomy



## Oropharyngeal Airways

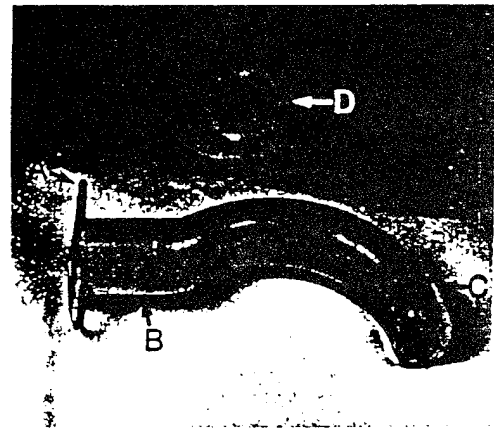
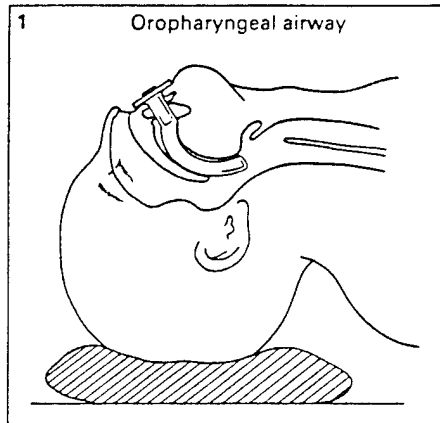


Figure 1.4 Oropharyngeal airway: (A) flange, (B) bite block, (C) stent, and (D) gas exchange or suction conduit.



Figure 3-21. Oral airway insertion using tongue blade.

## Nasopharyngeal Airways

52 PRINCIPLES OF AIRWAY MANAGEMENT

### NASAL AIRWAYS

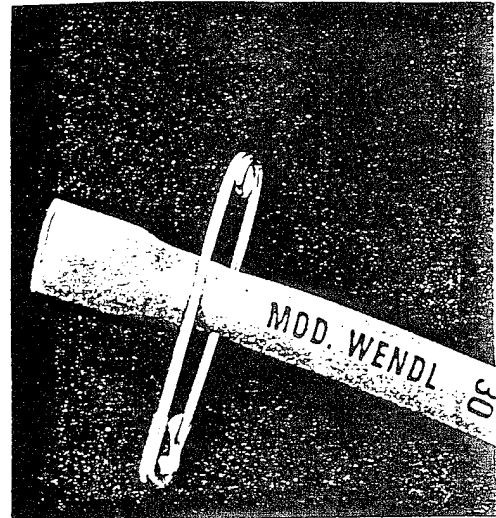
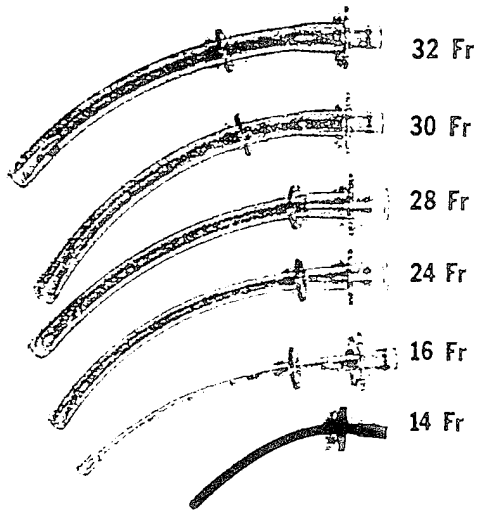
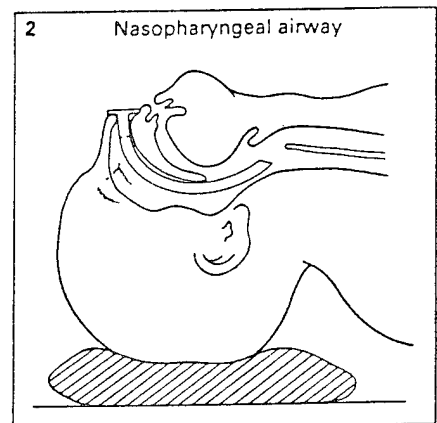


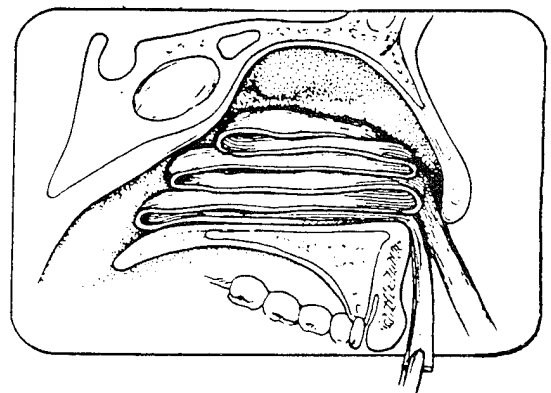
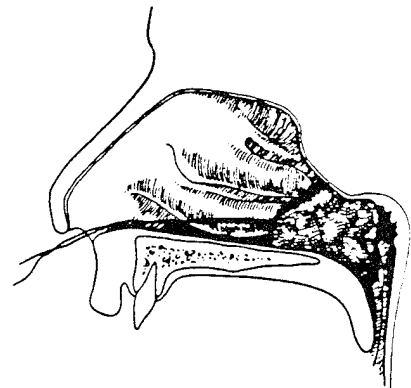
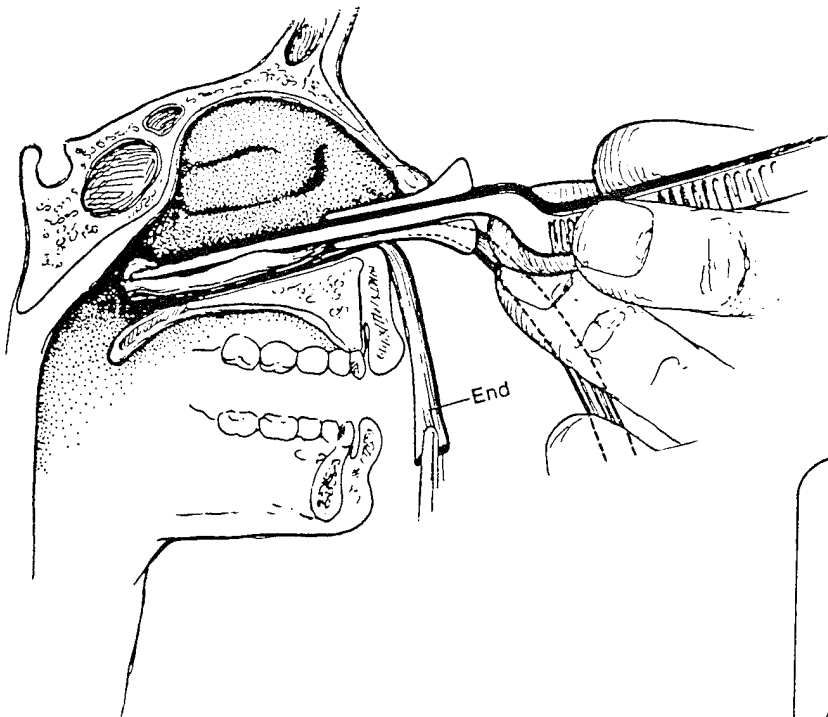
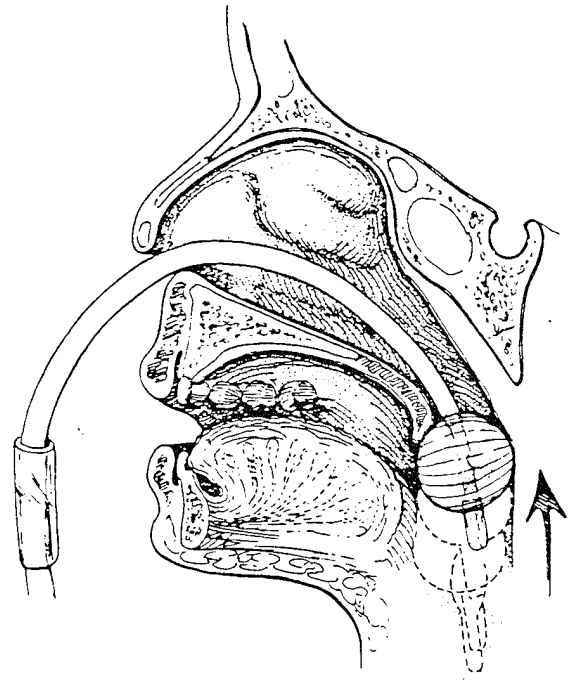
Figure 3-26. If a nasal airway does not have a conical or ring protector at its distal end, a safety pin may be used to prevent the airway from slipping into the nose and possibly down the trachea or esophagus.



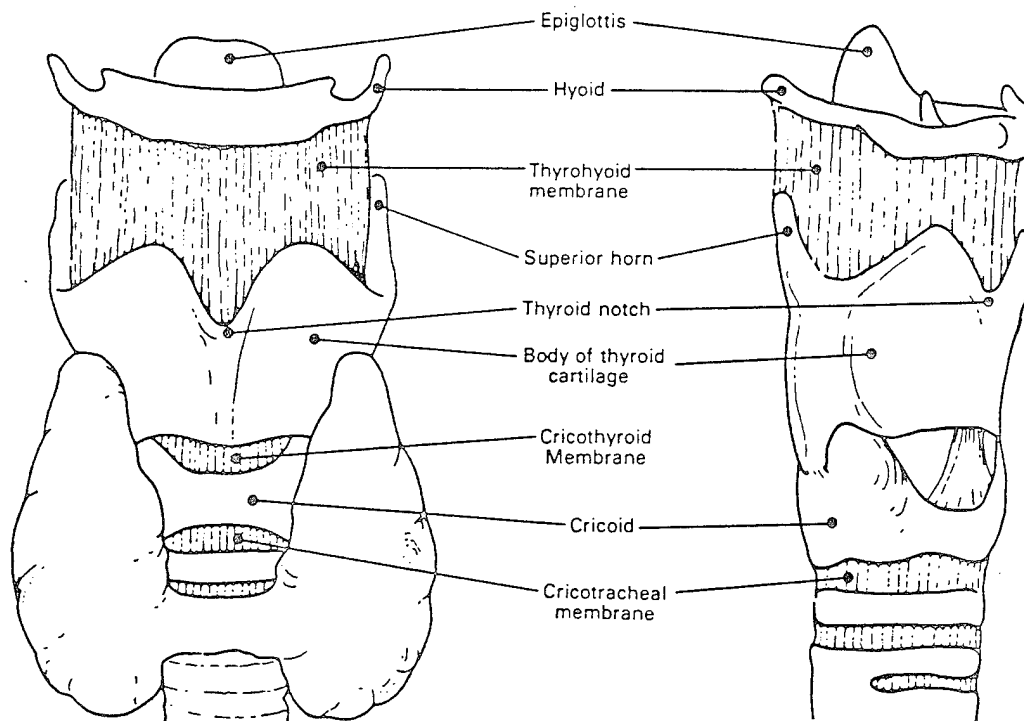
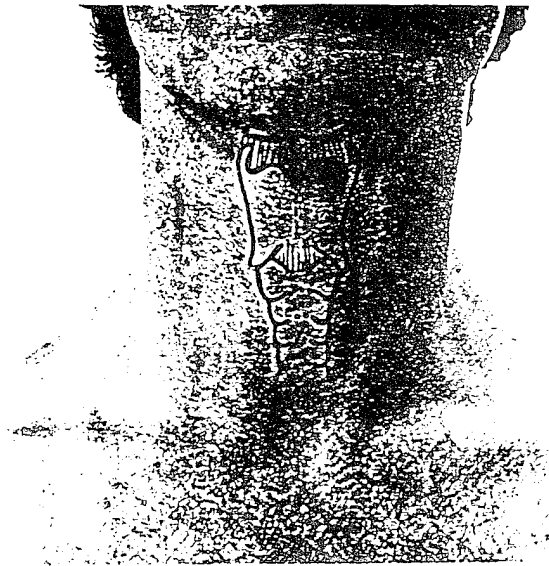
Figure 3-27. The nasal airway should be inserted directly posteriorly with the bevel toward the septum.



## Packing Nosebleeds



## Cricothyrotomy: Anatomy



## Cricothyrotomy

### Equipment

#### Something sharp to pierce the skin and cricothyroid membrane:

- \*Scalpel (#11 blade)
- \*14 gauge angiocath
- \*16 gauge Touhy needle
- \*Introducer needles from Cordis sheath or central line kits
- \*Cricothyrotomy kit introducer needle
- \*Swiss Army Knife

#### Something to maintain patency of puncture:

- \*Pediatric endotracheal tube (size 3.0 - 5.0)
- \*Pediatric sized reinforced (armored) endotracheal tube
- \*Pediatric tracheostomy tube or small adult trach tube
- \*Cricothyrotomy tube from kit
- \*Cordis sheath
- \*14 gauge angiocath
- \*flexible straw or other improvisational tube

#### Something to attach to the trans-puncture apparatus to adapt it to an oxygen source or an ambu bag:

- \*14 gauge angiocath or side port of a Cordis sheath to a 3 cc syringe (plunger removed) with a 7.5 / 15 mm ETT adaptor forced in where the plunger had been
- \*14 gauge angiocath directly attached to a 3.0 / 15 mm ETT adaptor
- \*14 gauge cannula attached to male end of IV extension tubing which is cut off after 1-2 inches and has a 2.5 / 15 mm ETT adaptor forced into it



**Cautions:**

The thyroid isthmus is very vascular and may be close to the cricothyroid membrane.

Confine the incision to 1 cm.

- \*Skin is usually incised vertically.

- \*Underlying cricothyroid membrane is usually incised horizontally.

Stabilize the larynx between the fingers when making the puncture.

Maintain hole patency with forceps or whatever if the hole is made by scalpel.

Aim the needle caudad (towards the buttocks) once the membrane is punctured, and thread the cannula in this direction.

The tracheal lumen can be recognized by bubbles coming up through the cannula, or by aspiration of air from the attached syringe.

- \*Stop advancing once air is aspirated. Going further may penetrate posterior wall of trachea and perforate the esophagus.

Air delivered through the cannula under pressure will exhaust through the glottis and out the mouth and nose in most cases of severe but partial obstruction.

- \*Total upper airway obstruction will prevent exhaust of expired gases.

- \*Jet ventilation under these circumstances will lead to barotrauma (pneumothorax, pneumomediastinum, pneumopericardium)

- \*Best ventilatory strategy is slow deep breaths to allow for exhaust through the high resistance cannula.

- \*Watch out for gastric distention from diverted exhausted gases; place a nasogastric or orogastric tube if possible.

- \*Recommended oxygen flow to the cannula is **3 liters per minute or less**

## Cricothyrotomy

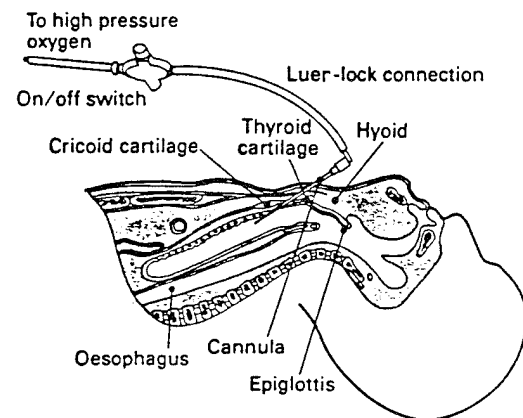


Fig. 45 Diagram to illustrate positioning of upper airway in relation to larynx and cannula. After Layman [131], with kind permission of the editor of *Annals of the Royal College of Surgery of England*.



**Ideas for Materials at Hand Which Might be Used**  
***IMPROVISATIONALLY***  
**To Maintain Airway Patency in an Emergency**

Plastic or rubber tubes or hoses

- \*Foley catheters, chest tubes, NG tubes, IV tubing, etc.
- \*Siphon tubing
- \*Radiator hoses
- \*Tubing to inflate things (e.g., stow float bags, Sport Pouches for cameras, air mattresses, bike tire pumps, etc.)
- \*Funnel tips
- \*Solar Shower hoses with the nozzle cut off

Tampons and tampon packaging

Flexible straws

Snorkel parts

Small flashlight casings

Small (rinsed-out) plastic bottles with the ends cut off

Pen casings (with sawed-off ends)

Safety pins

Big paper clips

Shoestrings

Dental Floss

Darning needles (which have bigger eyelets) or regular sewing needles

Buttons

Baby bottle lids and nipples with the ends cut off

Clothespins or clippies

Toothpicks, nails, awls, wire

Rubber Bands

Handle end of utensils, or utensils like an egg whisk, wooden spoon, etc.

Bandanas or cravats

Vasoconstrictors

- \*Nose drops or nose spray (Neosynephrine, Afrin, etc.)
- \*Cocaine
- \*Epinephrine or ephedrine
- \*Tea
- \*Boric acid eyewash

Tweezers

Walkman earphones (can make roll bar for anchoring tongue)

Bracelets

Channel-lock pliers

Tongs

Finger splints

Shower curtain hooks

Fish stringer Oral airways fashioned out of sticks and duct tape

Condoms as sleeves over rough-surfaced airway openers

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Friday, August 11, 1995

**COLD WEATHER  
SURVIVAL**

*Warren Bowman, MD*

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**WORKSHOP ON COLD WEATHER SURVIVAL**  
Second World Congress on Wilderness Medicine  
Aspen, CO, August 8-12, 1995  
Warren D. Bowman,, MD, FACP  
Cooke City, Montana

The cold weather survival workshop will be conducted outdoors but not, unfortunately, in the snow. Please try to read the syllabus material below before attending this workshop.

Objectives: After attending this workshop, the student should be able to:

1. Explain the layer system of clothing and describe preferred fabrics, clothing items, and layering sequences for cold weather outdoor travel.
2. Appreciate the insulating capacity of snow; describe and demonstrate the principles and building techniques of emergency survival shelters, including lean-tos and snow trenches.
3. Describe and demonstrate the techniques of gathering fuel and starting a fire under winter conditions.
4. List recommended items of winter survival equipment.

Since the end of World War II, more and more people have been venturing out into the winter wilderness to pursue hunting, snowmobiling, cross-country skiing, winter mountaineering, alpine skiing, winter camping, and other cold weather sports. Growth in expeditionary mountaineering places many climbers in regions where winter exists all year round. When modern conveniences are left behind, life is reduced to the basics and individuals become completely dependent on their own resources. Our ancestors' hard-won knowledge of how to survive in the cold may need to be relearned, sometimes at considerable cost.

Since death can occur if the human body core cools down to the temperature of a comfortable summer day, cold weather survival is an important topic for outdoor recreationists at any season of the year. Dangerous climactic conditions can exist in the arctic and the high mountains at all times of the year, and during the cooler months in temperate climates. It is of interest that more cases of hypothermia have been reported from moderately cold regions such as the British Isles and the State of Kentucky than from arctic regions. This is because of the especially dangerous combination of moderate cold, wind, and wetness seen in many areas, and because inhabitants of cold areas are more experienced at protecting themselves.

This workshop will emphasize preplanning, anticipation, always carrying a minimum of emergency survival equipment, and prevention of environmental emergencies rather than panic-stricken improvization.

For survival, the body requires a constant supply of oxygen, a body temperature regulated between the relatively narrow limits of 75oF to 106oF (24oC to 41oC), an adequate supply of water and food, and a generous amount of faith and the will to live. Physical conditioning and physical integrity (the absence of disease or illness) are also important. The requirements for survival, though listed separately, are interrelated. Since most deaths in the outdoors in winter are due to injury, or hypothermia, or both, maintenance of body temperature and physical integrity (through accident prevention) are probably the most important requirements for cold weather survival. Dehydration, starvation, and exhaustion make temperature maintenance more difficult and interfere with the rational thought and agility required to prevent accidents. Hypoxia becomes a contributing factor at extreme altitude, or in the case of avalanche burial or carbon monoxide poisoning due to cooking in an unventilated shelter. Food and water--while important--even if abundant will be of little value to the hypothermic dying of insufficient clothing and shelter. Lack of self-confidence, faith, and the will to live will foster an attitude of panic and defeatism that hinders the ability of the individual to take timely survival actions such as preparing a shelter and lighting a fire. Poor physical condition or the presence of illness or injury will interfere with heat production due to shivering, and hamper wood gathering, shelter building, and other physical activities needed to survive.

The most important human organ for survival is the brain, since voluntary actions such as preparedness, regulation of energy expenditure, adjustment of clothing, and seeking shelter are more important than involuntary mechanisms of adaptation to heat or cold. Since maintenance of core temperature is the most important short-term goal in cold weather survival, the subject must either be carrying enough insulation or know how to improvise enough insulation and/or provide enough external heat to maintain a satisfactory core temperature for an indefinite period of time.

Although most survival manuals provide many pages of instruction on how to "live off the land", the winter wilderness is a poor place to search for wild food and the amount of food found will rarely replace the energy expended in searching for it. In this workshop, preplanning and carrying a minimum of carefully selected emergency food will be emphasized.

Since decreasing heat loss through intelligent use of insulation is the most energy-efficient method of avoiding dangerous degrees of cooling, it will be discussed and demonstrated in detail. Heat loss occurs through the five familiar mechanisms of conduction, convection, evaporation, radiation, and respiration. Heat loss through conduction and convection can be prevented by the intelligent use of insulation and wind-proof materials.

Suitable materials fall into two general groups: woven fabrics and nonwoven fibers. Some nonwoven fibers, such as polyester pile, are incorporated into a fabric; others, such as down, are used as a filler to provide loft. Clothing should be worn in a number of thin layers so as to trap several layers of still air, which are warmed by body heat. The most effective fabrics are those that trap air and prevent its motion, and whose effectiveness is not reduced by becoming wet. The best of these currently are wool, polypropylene, and such types of treated polyester as Capilene and Thermax. Cotton has poor insulating value, especially when wet, and should be avoided in cold weather. Orlon, polyester, acrylic, and similar synthetics are also good insulators. The above fibers are typically worn as the innermost 2 or 3 layers--long underwear, shirt, sweater, and pants. Outer layers are normally chosen from fibers that produce loft, such as polyester and nylon pile and fleece, down, Dacron, Hollofil II, Quallofil, Thinsulate, and Thermolite. These are made into jackets, vests, and overpants. The outermost layer is preferably of a windproof and water resistant fabric such as Gore-Tex, a nylon/cotton blend, or similar material. Two or three layers are used when skiing, hiking, or building shelters, with a fourth layer added when stopping for lunch or a rest.

Heat loss by conduction is avoided by sitting on a log, foam pad, or other poorly conducting material rather than in the snow or on a cold rock, and by not touching metal or other good heat conductors with unprotected skin at low temperatures.

Heat loss by evaporation is avoided by wearing water-repellant outer garments to avoid wetting, by drying off quickly or changing to dry clothes when wet, and by removing layers when too warm in order to avoid excessive perspiring. Heat loss by radiation is avoided principally by wearing a hat, since circulation to the head is not reduced in the cold, and up to 70% of body heat production, for example, can be lost at 50F (-15oC) through an uncovered head. Special attention should be given to the protection of body parts with a large surface-area-to-volume ratio, such as the nose, ears, toes, fingers, and extremities in general. Mittens should be worn in preference to gloves, and hand coverings should be in layers, with the innermost a thin polypropylene glove liner, overlain with a thick pile or wool mitten and an outer windproof layer of leather or Gore-Tex. Tight boots and other garments that restrict circulation should be avoided. Hats should be of the ski cap variety, of wool or a suitable synthetic. In cold, windy weather, a face mask, balaclava, or combination of a ski cap plus a neck gaiter should be worn to protect the face. Boots should be double, and large enough to accomodate at least two pairs of heavy wool socks. In extreme conditions, give up and seek shelter. Windchill is a serious hazard that must be experienced to be appreciated.

Anyone who ventures out-of-doors in cold weather should carry



spare clothing for the most extreme environmental conditions likely to be experienced. It is also wise to never leave town without a knife and matches on your person.

The ability to improvise a wind and cold-proof survival shelter is an essential survival skill. If the snow cover is adequate, this should be constructed of snow, which is a very good insulator with heat conductivity 1/10,000 that of copper and about the same as wool felt. Satisfactory survival snow shelter designs should allow quick construction without wetting or chilling the builders. Every cold weather survival kit should contain a collapsable snow shovel of the small grain-scoop type, and a plastic or nylon tarp measuring about 8 X 10 feet. With the shovel, a wedge-shaped trench 4-6 feet wide at one end, 6-8 feet long, and 2-3 feet wide at the narrow end can be dug in about 20 minutes. The wide end is roofed over with the tarp and a fire built at the narrow end. You lie snug and warm under the tarp on your pack or natural insulation such as evergreen branches.

Snow caves are comfortable and warm but the classic type with a small, narrow entrance takes at least two hours to dig during which the builders usually become quite wet. Quin-zhee's have the same drawbacks. You should carry both a small grain scoop and a short, flat shovel of the French type for best results. A better and faster survival cave is an open snow-hole dug into the side of a hill, with the opening closed with snow blocks. If this option is selected, a snow saw is a useful tool since cutting blocks with a shovel or ski-tail is difficult. Igloos are the Taj Mahal of snow shelters but require practice and some engineering skill to erect properly and quickly.

If the snow cover is light, the best emergency shelter is probably an open lean-to made of the tarp, with a reflector fire built in front and the sides closed with brush.

In the author's opinion, the most practical snow shelter for multiday deep snow camping is a special trench design that allows for the maximum of snow around and above the occupants. Such a trench can be built on the level or on a slight incline. The door, which opens onto an entranceway where packs are kept, is narrow like that of a snow cave. The trench is 4 X 8 feet wide at the surface and is undercut so that the bottom is 6 X 10 feet or more. It should be at least 3 feet deep. Two pairs of skis and ski poles are placed on top and the tarp laid over these, with snow piled around its edges to hold it down. If the trench will be used as a basecamp, poles can be cut and used instead of skis and ski poles. Above timberline, snow blocks can be laid over the skis instead of the tarp.

With the entrance closed by a poncho, two candles alone will warm the inside of the trench to >20oF no matter what the outside temperature. You can cook safely inside the trench if you place

a ventilation hole above the stove. The author has slept comfortably in such a trench at -19oF.

The ability to build a fire under adverse conditions is another important survival skill that needs to be practiced. A cold weather survival kit (see below) should contain water-proof matches, a candle, firestarter, a sturdy knife, and a collapsable saw. The fire should be laid out of the wind. Tinder--dry shavings or the small, dead branches found on the lower trunks of evergreens--is laid against a large dead branch in lean-to fashion, with the small pieces on the bottom and larger ones on top. All the tinder is arranged so that air can reach each piece. A candle or fire starter is needed if the wood is damp; if wet, the wood should be shaved or split. The amount of wood needed to last all night is easy to underestimate, and is two or three times more than you think.

Because of the time and fuel required to melt snow or ice for water, advantage should be taken of open water when found. Treat it by filtration, chemical disinfection, or boiling if there is a question about its purity. Simply bringing water to a boil is probably effective at any altitude where contamination other than human is a problem [the boiling point of water at 18,000 feet (5500 meters) is about 179oF (81.6oC)]. Small streams and springs coming down from high, uninhabited areas at right angles to the main valley drainage pattern and streams coming from clean snowfields are safer to drink untreated than larger streams running parallel to the long axis of a valley. When water supplies are limited, avoid over-exertion with sweating (ration your sweat, not your water!).

#### COLD WEATHER SURVIVAL KIT

##### Shelter Building Equipment:

Plastic or nylon tarp  
Nylon cord, 1/8", 50 feet

Snow Shovel  
Folding saw

##### Fire Building Equipment:

Waterproof matches  
Candle

Firestarter  
Sturdy hunting knife

##### Signalling Equipment:

Whistle  
Card with ground-to-air signals  
Two quarters for pay phone

Signal mirror  
Flashlight

##### Other:

Compass

Map

Metal pot with bale	Metal cup
Toilet paper	First aid kit
Sunglasses	Sunburn cream
Lip salve	Canteen (full)
Spare mittens and sox	Emergency food
One extra layer of clothing, i.e. pile jacket and pile pants	
Ski poles that attach together to form an avalanche probe	

Optional:

Ensolite or Therm-A-Rest pad	Sleeping bag
Stove and fuel	Small ax
Snow saw	Bivouac sac

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**Friday, August 11, 1995**

# **AIR CRASH SURVIVAL**

*Brian Horner*

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*Please refer to material for Arctic Survival.*

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Friday, August 11, 1995

**FIELD WATER  
DISINFECTION**

*Howard Backer, MD*

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## FIELD WATER DISINFECTION

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Following this presentation, participants will be able to:

1. Identify the various means of disinfection available for field use and the chemical or physical basis for each.
2. Understand the effectiveness and limitations of each method.
3. Select a method(s) for disinfecting water in various travel and wilderness situations and properly use the method to ensure safe drinking water.

## FIELD WATER DISINFECTION<sup>1</sup>

Howard Backer MD

1995

Water disinfection indicates the removal of all enteric pathogens from drinking water. This is readily possible utilizing simple techniques in the field. However, there are several methods to accomplish the same goal; each has advantages and disadvantages. The specific environment and likely pathogens need to be considered, as well as space, weight, and individual preferences.

### Heat

Heat is the oldest and best known method and is very reliable. However, serious fuel limitations exist in many areas where natural fuel is scarce and all fuel must be carried. The 10 minute boiling rule is for sterilization of water, including destruction of heat-resistant bacterial spores, which are generally not enteric pathogens. Enteric pathogens, including cysts, bacteria, viruses and parasites can be killed at temperatures well below boiling, since thermal death is a function of both time and temperature: lower temperatures are effective with longer contact times.

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#### Thermal death points

*Giardia*, *E. histolytica* cysts: 60C (140F) for 2-3 minutes

*Cryptosporidium* oocysts: 65C for 1 minute

Enteric viruses: within seconds at 80-100C.

Enteric bacteria: within seconds at 100C.

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For example, pasteurization of food and beverages is accomplished at 150 F (65C) for 30 minutes or at 160F (70C) for 1-5 minutes. Much of the time required to raise water temperature to the boiling point, cooking or brewing time, or cooling time works toward disinfection, so water is safe to drink by the time it reaches a full boil. For an extra margin of safety, keep the water covered and hot for several minutes after boiling or boil for one minute. Boiling point decreases with lower atmospheric pressure at high elevations. However, for the same reasons given above, elevation

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<sup>1</sup>For a more detailed discussion and complete source references, refer to: Backer H. Field Water Disinfection. In: *Wilderness Medicine: Management of Wilderness and Environmental Emergencies*. Ed: Auerbach PS. Chapter 43, p:1060-1110. CV Mosby, third edition, 1995.

should not make a difference. A pressure cooker saves fuel and time at all elevations.

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Elevation	Boiling Point
10,000 ft	90C
14,000 ft	86C
19,000 ft	81C

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### Filtration and Clarification

Filtration is appealing because it is simple and adds no taste. Field filters that rely solely on mechanical removal of microorganisms may be adequate for cysts and bacteria, but do not reliably remove viruses, which are a major concern in water with high levels of fecal contamination (e.g., in developing countries). It is true that most viruses adhere to larger particles or clump together into larger aggregates that may be removed by the filter, but this is not adequate, since the infectious dose of enteric viruses may be quite small. Filters are also expensive, and for a large group, add weight and bulk.

Filter pore size required for reliable removal of microorganisms is not as apparent as it may seem. Microorganisms will vary from the textbook size and have some elasticity so they deform under pressure, squeezing through filter pores. Most field filters are depth filters with maze-like passageways that will trap particles and organisms smaller than the average passage diameter. It is more useful and important to know functional removal rate of certain organisms than the rated pore size of the filter. Good testing data are needed to back claims, but objective, comparative testing is not currently available.

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#### Average maximal pore size for removal of specific microorganisms

microorganism	micrometers (um)
Parasitic eggs and larvae	20
<i>Giardia</i> , <i>E. histolytica</i>	5
<i>Cryptosporidium</i>	3
enteric bacteria	0.4
Viruses	0.01
(note: viruses are too small for field water filtration)	

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Filters will also remove particulate debris, improving appearance and taste of some "dirty" water, but they clog quickly



if the water contains large particles.

Clarification of cloudy water can be achieved by several other means. Large particles will settle by gravity over a period of 1-2 hours by *sedimentation*. Smaller suspended particles can be removed by *coagulation/flocculation* (C-F). This is accomplished in the field by adding a pinch of alum (aluminum potassium sulfate) per gallon. (More may be added if necessary.) Mix well, stir occasionally for 30 minutes, then allow 30-60 minutes to settle. Decant or pour through a paper filter to remove the clumps of floc. C-F will remove contaminants that cause unpleasant color and taste, some dissolved metals and most microorganisms. Alum is used in the food industry (pickling powder) and is non-toxic.

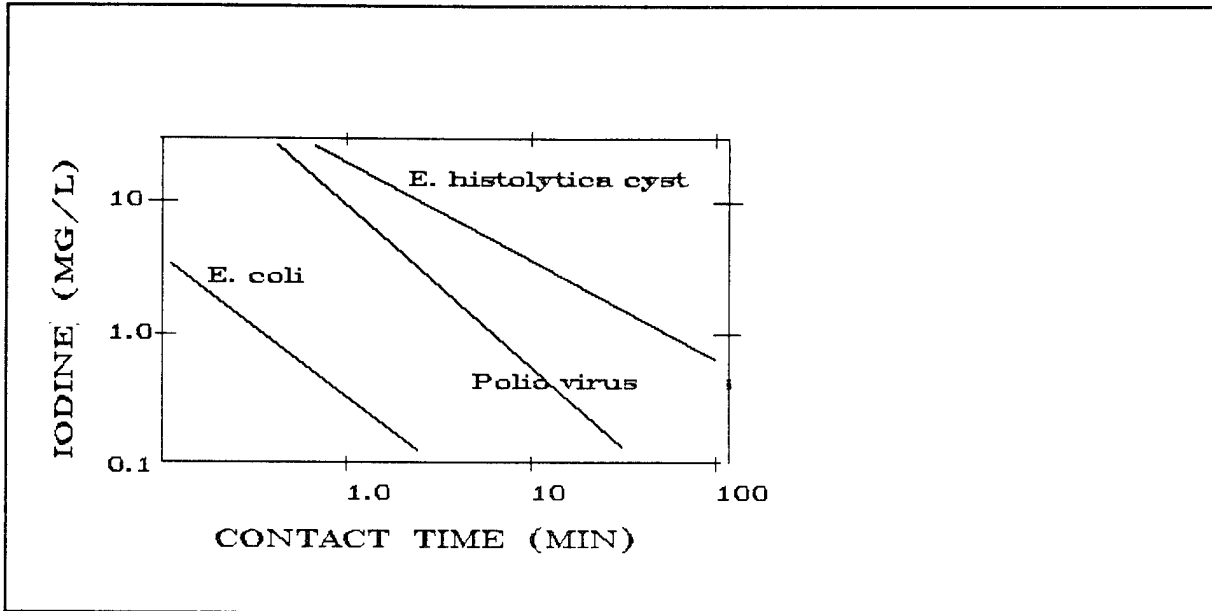
### Charcoal Resins

Granular activated charcoal (GAV) "purifies" by removing organic pollutants, chemicals and radioactive particles by adsorption. This improves objectionable color, taste, smell. While some microorganisms will adhere to GAV or become trapped in charcoal filters, GAV does not remove all microorganisms so does not disinfect. One rational use of GAV is to remove iodine or chlorine after disinfection. If used to remove halogen, one must wait until after the required contact time before running water through charcoal or adding charcoal to the water. (An exception may be filters that use iodine followed by GAV.)

### Halogens

Halogens (chlorine and iodine) are excellent disinfectants for bacteria, viruses, *Giardia* and amebic cysts, excluding *Cryptosporidium*. They are readily available and inexpensive. However, to achieve reliable results and reasonable taste, some understanding of the process is necessary. Disinfection with halogens proceeds like a chemical reaction: major factors are the concentration of halogen (mg/l or ppm--equivalent measures) and the time it is in contact with the water (contact time). An increase in one allows a decrease in the other. Minor factors are temperature (cold slows reaction time) and organic contaminants in the water, which react with halogen and decrease its disinfectant action. In cold water, the contact time should be increased, but in polluted water, the dose must be increased. Although clear mountain water probably has minimal halogen demand, some impurities (at least 1 mg/liter) must be assumed, so it is prudent to use 4 mg/l as a target concentration for surface water and allow extra contact time, especially if the water is cold. In cloudy water that

will not settle out by sedimentation, the dose of halogen should be at least 8 ppm to account for greater halogen demand from organic material. Even better, use C-F to clarify this water first, then smaller doses of halogen.



**Figure 1** Graph of halogen concentration vs. time for 99.9% kill of microorganisms. Note relative susceptibility of microorganisms.

Vegetative bacteria are extremely sensitive to halogens; viruses and *Giardia* require higher concentrations or longer contact times. *Cryptosporidium* cysts are extremely resistant to halogens. Although *Cryptosporidium* oysts have been found in surface water and have been identified as the etiologic agent in some cases of traveler's diarrhea and some municipal waterborne outbreaks, it is unclear how much risk they pose in wilderness water. Certain parasitic eggs, such as *Ascaris*, are also resistant, but these are not usually spread by water. These resistant eggs and cysts are susceptible to heat or filtration.

Both chlorine and iodine are available in liquid and tablet form. Iodine has some advantage over chlorine for field disinfection: it is less affected by pH or nitrogenous wastes, and the taste is better tolerated at effective levels. Halogens can be applied with equal ease to large and small quantities of water. For small groups, collapsible plastic containers can be used to disinfect water with low doses of iodine during the day or overnight, or higher doses can be used, followed by chemical

reduction, to remove taste. Iodine resins that disinfect leaving low concentrations of iodine dissolved in the water have been incorporated into many different filter designs available for field use.

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**Experimental data for 99.9% kill with Chlorine**

Concentration	Time	pH	Temp
<i>Giardia</i> (consistent with <i>E. histolytica</i> )			
0.5 mg/l	6-24 hrs	6-8	3-5C (37-41F)
4.0 mg/l	60 min	6-8	3-5C
8.0 mg/l	30 min	6-8	3-5C
3.0 mg/l	10 min	6-8	15C (59F)
1.5 mg/l	10 min	6-8	25C (77F)
Enteric viruses			
0.5 mg/l	40 min	7.8	2C
0.3 mg/l	30 min	7.8	25C
<i>E. coli</i>			
0.03 mg/l	5 min	7.0	2-5C

**Experimental data for iodine**

Concentration	Time	pH	Temp
<i>Giardia</i> and Ameba cysts			
3.0 mg/l	15 min	7.0	20C
7.0 mg/l	30 min	7.4	3C
Polio virus			
20 mg/l	1.5 min	7.0	25C
<i>E. coli</i>			
1.0 mg/l	1 min	6.5-8.5	2-5C

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There is concern over the physiologic activity of iodine. Iodine has been used experimentally to disinfect drinking water for up to 3 years in adults with no adverse health effects. However, iodine use is not recommended for people with unstable thyroid disease, known iodine allergy, and during pregnancy for periods longer than several weeks (due to risk of neonatal goiter). Despite the studies referred to above, caution dictates recommending against iodine use for longer than several months in any individual.

See disinfection device tables for further discussion of iodine and chlorine products.

**Problems with halogen use:**

- 1) taste can be unpleasant when concentrations exceed 4-5mg/l.
- 2) the potency of some products (tablets and solutions) decrease with time and are effected by prolonged exposure to moisture or heat (tablets) and air (iodine crystals).
- 3) liquids are corrosive and stain.
- 4) actual concentration (after halogen demand) is not known.

**Taste may be improved by:**

- 1) adding drink flavoring after adequate contact time.
- 2) using charcoal (GAV) to remove halogen after contact time.
- 3) reducing the concentration and increase the contact time in clean water (as above).
- 4) using a technique that does not leave significant residual
- 5) iodine and chlorine taste and iodine color can be removed by adding a few granules/liter of ascorbic acid (vitamin C, available in powder or crystal form) or sodium thiosulfate (non-toxic, available at chemical supply) after the required contact time. These chemicals reduce iodine or chlorine to iodide or chloride, which have no taste or color. Ascorbic acid leaves a slight tart taste of its own. Iodide still has physiologic activity.

**Preferred Technique**

The optimal technique for an individual or group will depend on the number of persons to be served, space and weight available, quality of source water, personal taste preferences, and availability of fuel. Unfortunately, optimal protection for all situations may require a two step process of filtration or C-F and halogenation, since halogens do not kill *Cryptosporidium* and filtration misses some viruses. Heat works as a one step process but will not improve aesthetics if the water is cloudy or poor tasting. The iodine resins combined with microfiltration to remove resistant cysts are also a viable one step process for all situations. Other single step solutions can be used when reasonable water quality assumptions can be made.

For alpine camping with high quality source water, heat, mechanical or iodine resin filtration, or halogens in low doses can be used. Heat is limited by fuel supplies. Filtration has the advantage of imparting no taste and requiring no contact time.

Water with agricultural runoff and/or sewage plant discharge from upstream towns or cities should be treated with a two step process of filtration to remove *Cryptosporidium*, then halogens to assure viral destruction. An iodine resin filter with

microfiltration is an alternative. A filter containing a charcoal element has the added advantage of removing chemicals such as pesticides.

Surface water in undeveloped countries, even if clear, should be treated as highly contaminated with enteric pathogens. Heat is effective. Simple filtration is not adequate. Halogens are reasonable but will miss *Cryptosporidium* and parasitic eggs. A two stage process as above offers added protection.

Cloudy water in developed or undeveloped counties that does not clear with sedimentation should be pretreated with C-F, then disinfected with heat or halogens. Filters may clog rapidly with silted or cloudy water.

In systems where the water will be stored for a period of time, such as on a boat or a home without running water, halogens have a distinct advantage. When only heat or filtration is used prior to storage, the water can become recontaminated or bacterial regrowth can occur. Superchlorination/dechlorination is especially useful in this situation, because high levels of chlorination can be maintained for long periods, and when ready for use, the water can be poured into a smaller container and dechlorinated. If another means of chlorination is used, a minimum residual of 3-5 mg/L should be maintained in the water. Iodine will work for short but not for prolonged storage, since it is a poor algicide.

On long-distance, ocean-going boats where water must be desalinated during the voyage, only reverse osmosis membrane filters are adequate.

**Water Disinfection Techniques and Halogen Doses**

<b>Iodination techniques</b> added to 1 liter or quart of water	amount for 4 ppm	amount for 8 ppm
Iodine tabs tetraglycine hydroperiodide EDWGT (emergency drinking water germicide tablet) Potable Aqua Globaline	1/2 tab	1 tabs
2% iodine solution (tincture)	0.2 ml 5 gtts	0.4 ml 10 gtts
10% povidone-iodine solution	0.35 ml 8 gtts	0.70 ml 16 gtts
Saturated iodine crystals in water	13 ml	26 ml
Saturated iodine crystals in alcohol	0.1 ml	0.2 ml
<b>Chlorination techniques</b>	amount for 5 ppm	10 ppm
Halazone tabs mono-dichloraminobenzoic acid	2 tabs	4 tabs
household bleach 5% Sodium hypochlorite	0.1 ml 2 gtts	0.2 ml 4 gtts

(Measure with dropper (1 drop = 0.05 ml) or tuberculin syringe.  
Povidone-iodine solutions release free iodine in levels adequate  
for disinfection, but scant data are available.

Concentration of halogen	Contact time in minutes at various water temperatures		
	5 C	15 C	30 C
2 ppm	240	180	60
4 ppm	180	60	45
8 ppm	60	30	15

**Note:** Recent data indicate that very cold water requires prolonged  
contact time with iodine or chlorine to kill *Giardia* cysts. These  
contact times in cold water have been extended from the usual  
recommendations to account for this and for the uncertainty of  
residual concentration.

[disinf6.syl]

<u>Product/Manufacturer</u>	<u>Price</u>	<u>Structure/Function</u>
Katadyn U.S.A., Inc. 3020 N Scottsdale Rd Scottsdale, AZ 85251 (602) 990-3131		All filters contain a 0.2 micron ceramic candle filter; silver impregnated to decrease bacterial growth. Large units also contain silver quartz in center of filter.
Katadyn Pocket filter	\$240	hand pump; 40" intake hose & strainer, zipper case; size: 10" x 2"; wgt: 1 lb 9 oz; flow: 3/4 qt/min.
Replacement filter element	\$120	
Mini filter	\$140	smaller, lighter hand pump; 31" intake hose and strainer, hard plastic enclosure and pump; size: 7 x 3.5 x 1.75"; wgt: 9 oz; flow: 1/2 L/min; capacity: approx 7,000 L.
Handpump filter KFT	\$725	Large hand pump with steel stand; size (packed in case): 23 x 6 x 8"; wgt: 10 lbs 13 oz; flow: 1.5-3 qt/min.
Replacement filter element	\$40	
Drip filter TRK	\$250	Gravity drip from one plastic bucket to another with 3 ceramic candle filter elements; size: 18" x 11" diameter (26" high when assembled); wgt: 9 lbs 4 oz; flow: 1 pt/hr (10 gal/day).
Replacement filter (same filter element as handpump)	80	
S Syphon	\$92	Gravity siphon filter element: 12 x 2"; wgt: 2lb; flow: 2 gal/hr.
Timberline Filter	\$24	2 micron fiberglass and polyethylene matrix; hand pump; size: 9" x 1-3"; wgt: 6 oz; flow: 1 qt in 1.5 min.
replacement element	\$12	
BaseCamp	\$50	Gravity drip unit with pre and post filter reservoir bags, filter unit in-line between bags; size: 5" x 10" empty and folded; wgt 12 oz; flow: 0.8 L/min; capacity: approx 50 gal.
Replacement filter	\$25	
Timberline Filter 211 Pawnee Dr Boulder, CO, 80303 (800) 777-5996		

### Katadyn Filters

#### Claims

Removes bacterial pathogens, protozoan cysts, parasites, nuclear debris. Clarifies cloudy water. If filter clogs, flow can be restored by brushing filter element--this can be done hundreds of times before needing to replace filter element. Claims for removal of viruses not made in USA, although testimonials offered imply effectiveness in all polluted waters.

#### Comments

Well-designed, durable products. Effective for claims. Pocket Filter is the original, individual or small group filter design. Minifilter was designed to be lighter and more cost competitive. Handpump filter is popular for larger groups, especially river trips where weight is not a factor. Complete virus removal cannot be expected, although it is true that viruses usually clump or adhere to larger particles that can be filtered. Silver impregnation does not prevent bacterial growth in filters. With any filter, it is recommended to pump dilute bleach solution through the unit after each trip, before storage.

This information is updated regularly. However, product lines are continuously evolving, and prices change frequently and vary widely. Comments, corrections and additions are appreciated. FAX comments to (510) 601-5134.

For most of these products, claims are substantiated only by company sponsored and designed testing and may have been extrapolated to similar products. Within the next year, objective comparative testing of mechanical and iodine resin filters, using a standard protocol proposed by the EPA, should be available.

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### Timberline filters

#### Claims

Removes *Giardia* cysts.

No claims for bacteria or viruses.

#### Comments

Effective for claims; intended only for high quality North American backcountry use where *Giardia* is a possible contaminant, but should also remove *Cryptosporidium*. Lightest pump filter available.



<u>Product/Manufacturer</u>	<u>Price</u>	<u>Structure/Function</u>
General Ecology, Inc. 151 Sheree Blvd. Exton, Pa. 19341 (215) 363-0412		All filters (except Microlite) contain 0.1 micron (0.4 micron absolute) carbon matrix filter in removable cannister.
First-Need Direct Connect Water Filter	\$45	Hand pump with intake strainer; outflow end connects directly to common water bottle; size: 6" x 6", wgt: 15 oz; flow: 1 pint/min; capacity: 100-400 liters.
extra cannister	\$25	
pre-filter replacement	\$10	
new pump assembly	\$23	
Filtermate	\$8	connects older design filter to wide-mouth nalgene bottle
Matrix pumping system	\$9	Two liter carry bag, polyethylene liners, 18" hose and hose adapter for creating gravity filter unit from one of the filter elements above.
Trav-L-Pure (carrying case included)	\$120	Filter and hand pump in rectangular housing (1.5 pt capacity); pour water into housing, then pump through prefilter and microfilter; size: 4.5 x 3.5 x 6.75"; wgt: 22 oz; flow: 1-2 pt/min; capacity: 100-400 liters.
replacement cannister	\$30	
Base Camp (carrying case included)	\$500	Stainless steel casing and hand pump connected with tubing; capacity 1000 gal;
replacement cartridge	\$60	canister size 4.8 x 5.4"; pump 1.5 x 10.5"; wgt: 3 lbs; flow: 1.5 L/min
Microlite	\$30	Structured Matrix™ filter 0.5 microns (nominal) with activated carbon; hand pump, 24" intake hose and strainer; attaches directly to wide-mouth or bike bottle, soda bottle, or use outlet spout; size: 5.5" high x 2.5" dia; wgt: 8 oz; flow: 0.5 L/min; capacity: 50 L/cartridge.
Replacement cartridges (set of two)	\$10	

## General Ecology filters

Claims

"Microfiltration" with 0.1 micron retention (0.4 absolute) "removes bacteria and larger pathogens" (cysts, parasites). No claims for viruses: Trav-L-Pure comes with iodine tabs for pretreatment if viral contamination suspected. "Adsorption and molecular sieving": carbon adsorbers remove chemicals and organic pollutants that cause color and taste. Does not remove all dissolved minerals or desalinate. "Ionic charges remove colloids and ultra-small particles."

Microlite removes sediment, protozoal cysts, algae, chemicals (including iodine), and improves color and taste of water. Iodine tablets included to kill bacteria and viruses when these organisms are a concern.

Comments

Reasonable design, cost, and effectiveness. All units (except Microlite) use same basic filter design. Most testing with *E. coli* and *Giardia* cysts show excellent removal. Charcoal matrix will remove chemical pollutants. Despite testimonials for effectiveness in undeveloped countries, recommend caution where viruses may be a problem; prior disinfection with halogen would guarantee disinfection, and carbon would remove halogen. "Ionic surface charges" are not likely to play a significant role for microorganisms, but may help remove colloids--fine suspended particulate matter.

The Microlite is designed primarily for day-use or light backpacking. Used alone, it makes microbiologic claims for protozoal cysts (*Giardia* and *Cryptosporidium*) only. Iodine tablets or solution should be used as pretreatment for all water except pristine alpine water in North America. This filter is compact, light-weight and well-designed for low volume use with inexpensive, easily changed filter cartridges.

<u>Product/Manufacturer</u>	<u>Price</u>	<u>Structure/Function</u>
Basic Designs Ceramic Water Filter	\$69	Ceramic candle filter with 0.9 micron absolute retention size and carbon center; filter is at the bottom of a heavy plastic reservoir bag with an outflow tube connected to a collection bag; gravity drip, or squeeze bag to increase flow rate; packing size: 4 x 4 x 8"; wgt: 13 oz; flow (if bag is squeezed): 1 L/4 min; capacity: up to 1000 L.
High Flow Ceramic Water Filter	\$89	Gravity filter with larger capacity bag (7.5 L) and six foot tubing providing 2-3 lbs hydrostatic pressure through in-line ceramic and carbon filter; flow rate: 10 L/hr.
Ceramic Filter Pump Replacement filter	\$26 13	Handpump with ceramic cartridge at end of intake tubing and polyurethane prefilter; size: pump 8 x 1", filter 4 x 3", 18" tubing; wgt: 7 oz; flow: 0.4L/min; capacity: 500 gal.
Basic Designs Santa Rosa, CA 95404 (707) 575-1220		
Water One	\$50	Charcoal block, 0.4 micron filter; prefilter sponge 30-50 micron. Bulb hand or foot pump generates 3-5 lbs pressure; back-wash to unclog. Size: 3" x 6" cartridge with about 7 ft of tubing and bulb pump; wgt: 1 lb; capacity 400 gallons or 3 yrs.
Calco Ltd 7011 Barry Ave Rosemont Illinois 60018 (708) 296-6615		

### Basic Designs filters

#### Claims

Ceramic filter removes *Giardia*, bacteria, *Cryptosporidium*, cysts, tapeworm, flukes, other harmful pathogens larger than 1 micron, and bad taste. Carbon removes color, tastes and odors. Filter can be cleaned with an abrasive pad. Pump is easily serviced in the field; ceramic cartridge is replaceable.

#### Comments

Ceramic candle filters are effective filtering elements, and charcoal is an effective adsorbent. No claims for virus removal. 0.9 microns is large for bacterial removal, although a low pressure depth filter this size could trap most of them. The simple gravity design decreases cost and moving parts. Filtration rate will be slow, and this filter could clog rapidly, since there is no prefilter for larger particulates. The Basic filter is too slow and squeezing the bag is a poor solution. The High Flow filter is more practical than the Basic Filter due to faster filtration rate and larger reservoir capacity. The Filter Pump is the most practical and is reasonably priced.

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### Calco Water One filter

#### Claims

Removes *Giardia*; no claims for bacteria, viruses. Unbreakable, 2 year guarantee. Comes with dye to test filter integrity.

#### Comments

Should be effective for claims made. Charcoal will remove most chemical pollutants and halogens--so filter could be used as second stage after halogen disinfection of water which may contain bacteria and viruses. Bulb pump is too stiff for hand pumping, but is actually intended for foot use. Filter plus tubing is heavy and bulky compared to other filters with similar capacity.

<u>Product/Manufacturer</u>	<u>Price</u>	<u>Structure/Function</u>
MSR Waterworks Total Filtration System	\$140	Four filter elements of decreasing pore size: porous foam intake filter, 10 micron stainless steel wire mesh screen, activated carbon filter (ceramic/carbon filter optional, may soon be standard), then 0.1 micron absolute membrane filter; hand pump with intake tubing; storage bag (2 or 4 liter) attaches directly to outlet of pump. size: 9 x 4 x 3"; wgt 18.4 oz; flow rate: 1 liter/90 sec.
Dromedary Beverage Bag  (All filter elements and parts replaceable.)	\$13/\$20	
Mountain Safety Research Box 3978 Terminal Station Seattle, WA 98124 (206) 624-7948		
<hr/>		
Reverse Osmosis Filters		
Survivor 06	\$550	Hand operated pump, reverse osmosis membrane filter with prefilter on intake line; size: 2.5 x 5 x 8"; wgt: 2.5 lb; flow: 1 L/hr.
Survivor 35	\$1425	Hand operated pump, reverse osmosis membrane filter with prefilter on intake line; size: 3.5 x 5.5 x 22"; wgt: 7lbs; flow: 1.2 gal/hr.
Recovery Engineering, Inc. 2229 Edgewood Ave South Minneapolis, MN 55426 (800) 845-7873		

## MSR filter

Claims

Removes protozoa (including *Giardia* and *Cryptosporidium*), bacteria, pesticides, herbicides, chlorine, discoloration. Design and ease of use are distinct advantages. Filter can be easily maintained in the field; maintenance kit and all replacement parts available.

Comments

Excellent filter design and function. Prefilters protect more expensive inner, fine pore filters. Should be effective for claims made. No claims made for viruses. Many would be removed by clumping and adherence to larger particles, but this should not be considered reliable for highly polluted waters in developing countries. Attaching reservoir bag for filtered water storage is a nice addition.

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Recovery Engineering Reverse Osmosis FiltersClaims

Reverse osmosis units desalinate, removing 98% salt from sea water by forcing water through a semipermeable membrane at 800 PSI. In the process, bacteria are filtered out. The manual operation of these units make them unique and useful for survival at sea or for use in small craft without power source. Larger, power operated units also available.

Comments

Reverse osmosis units are included here because sea kayaking and small boat journeys in open water are becoming more popular. These units can obviate the need for large water storage containers or add a margin of safety. I do not have good test data for these products, but desalinators should remove microorganisms, including viruses. Note that the company does not make claims for viral removal because they assume that the membrane is imperfect and some pores will be imprecise, perhaps allowing viral passage. Reverse osmosis filters could be used for land-based travel, but are prohibitively expensive for most people.

<u>Product/Manufacturer</u>	<u>Price</u>	<u>Structure/Function</u>
Water Technologies Corp 14405 21st Ave N, Suite 120 Plymouth, MN 55447 (800) 627-0044		All products use Pentacide iodine resin under tradename of PentaPure.
Travel Cup	\$25	Gravity pour through; size: 3" x 4"; wgt: 6 oz; flow: 0.5 pint/min; capacity 100 gallons.
20 micron prefilters (#6)	\$3	
Penta Pure Water Jug	\$22	Collapsible 2 gallon container with iodine resin cartridge at outpour spout; size: collapses to 8.5 x 8.5 x 7"; wgt: 13 oz; flow: 20-30 oz/min; capacity: 20 gal.
replacement cartridge	\$17	
Travel Tap Faucet Filter	\$80	Sediment filter, Pentacide and carbon cartridge; attaches to any faucet without tools; length: 6"; flow: 0.5 gal/min; capacity 200 gal or 12 months.
The straw		Drink-through straw; cartridge with prefilter, granular activated carbon filter sandwiched between two stages of PentPure resin; size: 5.5" long; wgt: 1 oz; capacity: 25 gal.
(EPA registration submitted but not obtained for products below, so currently sold only outside USA. Contact company for these products.)		
Micro-Pure Hand Pump	\$130	Hand or foot operated bulb pump; sediment filter, PentaPure and carbon cartridge; size: 7 x 2" cartridge, 50" tubing; wgt: 1 lb 12 oz; flow: 1.5 qts/min; capacity 500 gal.
replacement cartridge	\$90	
Penta-Pour Bucket	\$200	Gravity drip bucket with 3 gal holding capacity; sediment filter and pentacide and carbon cartridge; size: 12" x 30"; wgt: 2.5 kg; flow: 10 gal/hr; capacity: 2,000 gal.
replacement cartridge	\$100	

## Water Technologies Corp. iodine resin filters

Claims

Resin releases iodine "on demand", on contact with microorganisms; minimal iodine dissolves in water: effluent 1.0-2.0 ppm iodine. Charcoal removes any residual dissolved iodine. Tested effective for bacteria, *giardia*, schistosomiasis, viruses-- including hepatitis.

Comments

General testing data is convincing for iodine resins, which appear to be a major breakthrough in water disinfection. Iodine apparently binds to microorganisms aided by electrostatic forces and penetrates more readily than in a dilute iodine solution, but the exact mechanism of iodine transfer to organisms is not known. Organisms are effectively exposed to extremely high iodine concentrations when passing through resin, allowing reduced contact time. However, note that some contact time is necessary, especially for cysts. The effectiveness of individual products depends on effectiveness of the resin matrix assuring contact of every microorganism with iodine resin (no channeling of water). Carbon to remove residual dissolved iodine is an excellent addition that theoretically does not decrease the effectiveness of the resin, but the original tests on iodine resins was not done with residual iodine removed. *Cryptosporidium* oocysts may become trapped in the resin, but of those passing through, half are viable at 30 minutes. More test data needs to be available for these products to assure that charcoal does not decrease the effectiveness of the iodine and that the product can remove or destroy *Cryptosporidium* cysts. Uniform testing of individual products has not been done--results are extrapolated from a common resin product.

The company has developed a large number of new products applicable to different size groups and various settings. While all these products are already produced and sold in Europe, some are not yet available in the U.S.; contact the sales department. The most rational products are the Water-jug and Bucket, and the Travel Tap. The Travel Cup is much too slow and gives only small quantities. The Straw has limited applications. The Hand Pump bulb is quite stiff and not as easy as a pump handle; and its cartridge with tubing are bulky. The collapsible Water Jug is well conceived, except the plastic valve is fragile and does not work smoothly. The Travel Tap is an excellent design, a little heavy, but is intended for hotel travelers and residents.



<u>Product</u>	<u>Price</u>	<u>Structure/Function</u>
PUR Explorer	\$140	Hand pump with 130 micron prefilter, and replaceable cartridge with 1 micron pore size fiber/membrane filter and tri-iodine resin matrix; self-contained brushes clean filter with twist of handle. Optional carbon cartridge attaches to effluent end to remove residual dissolved iodine and other chemicals. size: 10.75" x 2.25", intake and output hoses: 3 ft; wgt: 21 oz; max flow 1.5 L/min; capacity: 500 gal/cartridge.
replacement parts		
Tritek cartridge	\$45	
pump	\$45	
intake filter/hose	\$16	
Optional bottle adaptor	9	
PUR Scout	\$64	Hand pump with 150 micron intake filter, 1 micron membrane filter and tri-iodine resin; optional carbon cartridge; size: 9" x 2.25"; wgt: 12 oz; max flow: 1.0 L/min; capacity: 500 gallons.
replacement cartridge	\$35	
Optional carbon cartridge	\$20	
PUR Traveler	\$70	Small filter/purifier designed for travelers to disinfect one glass of tap or well water at a time. No prefilter; pour water into 135 ml chamber, then press hand piston to pump into cup provided. 1 micron fiber/membrane filter and tri-iodine resin matrix. Size: 6.5 x 2.5 "; wgt: 12 oz; capacity: 200 gal/cartridge.
replacement cartridge	\$30	
PUR Hiker	\$45	Handpump with 0.5 micron pleated glass fiber microfilter and activated carbon core (optional resin will be available); intake filter for particulates; intake and outflow tubing about 3 ft long; size 7.5 x 2.5 x 3.5"; max flow: 1L/min; capacity 200 gal.
replacement filter	25	
Recovery Engineering, Inc.		
2229 Edgewood Ave South		
Minneapolis, MN 55426		
(800) 845-7873		

Recovery Engineering, PUR water filters

Claims

Microfilter removes cysts and iodine resin kills bacteria and viruses on contact. Explorer has unique self-contained brush to clean filter without disassembling. Leaves no iodine taste. Filter will clog before resin is exhausted. The iodine resin filters will purify (render microbiologically safe) water of any quality. However, two passages through the filter are recommended for "worst case" water (below 5C and highly polluted).

The Hiker is designed for higher quality surface water, not international travel. It will "eliminate Giardia and most bacteria"; activated carbon core "reduces chemicals and pesticides, plus improves taste of water." Filter surface area of 126 square inches is "guaranteed not to clog for 1 year".

Comments

(See discussion on page 4B) Iodine resins have been shown to be effective disinfectants leaving minimal residual iodine in the water. Although the resins are effective for *Giardia* cysts, the microfilter should effectively remove them, as well as *Cryptosporidium* and any other halogen-resistant parasitic eggs or larva. Thus these filter/purifiers are one of the few products designed to eliminate the risk of all enteric pathogens in one step. Since bacteria and viruses are killed very rapidly by iodine resins, no significant contact time is required for most water, but a short waiting time is advised. The Explorer is a well-designed, light-weight unit for individual or small group use in any wilderness environment. The pumping action is very easy, and the internal brush is a great idea that seems to effectively clean the membrane and restores flow. The Scout is less expensive and slightly smaller without the internal brush. The Antimicrobial Water Purifier is for hotel travelers who want only a small glass of water at a time, for brushing teeth, etc. Instructions advise passing cold highly-polluted water through this filter twice, but an alternative would be to allow 30-40 minutes of contact time. This limitation of the Antimicrobial Water Purifier and of the other filters, since this test data has been applied to the other products) has not been explained: presumably it is limited time in the filter and the necessity of a contact time. The company is hesitant to recommend a contact time, feeling that the public expects a filter to render water safe immediately after passage, so they offer the more cumbersome recommendation of filtering twice. Further research is needed to determine whether this is a limitation of the resin or an indication of the need for contact time in worst quality water. The Hiker was designed for the domestic backpacking market--but will soon have an auxillary iodine resin cartridge for foreign travel. All of these products are well-designed.

<u>Product/Manufacturer</u>	<u>Price</u>	<u>Structure/Function</u>
SweetWater Filter 20505 Trade Center Ave Longmont, CO 80503 (303) 678-0447		Lexan body and pump handle; 100 micron metal pre-filter; in-line 4 micron secondary filter; labyrinth filter cylinder of borosilicate fibers removes pathogens to 0.2 micron; granular activated carbon; safety pressure relief valve; outflow tubing has universal adapter that fits all water bottles; optional biocide
The Guardian Micro-filtration system	\$50	cartridge containing iodinated resin attaches to filter--water passes through resin first, then filter cartridge, then GAC; optional input adaptor that attaches to sink faucet while traveling; size: 7.75" x 3.5"; wgt: 8 oz; flow: 1 L/min; capacity: 200 gal (90 gal with viral-guard).
Replacement Filter Cartridge	\$20	
Viral Guard iodine resin cartridge	\$25	
Tap-Adapt	\$10	
Accuventure, Inc. 9915 S.W. Arctic Dr Beaverton, OR 97005 (800) 422-1820		Drink-through products in three forms: straw, military canteen and sport bottle insert; 3-stage products use mechanical filtration through coconut shell, carbon matrix and membrane filter with final pore size of 4 microns; 5- stage product line contains three filtration stages with iodine resin and activated charcoal.
AccuFilter Straw		The Fountain connects to a water faucet, producing a stream of water. Straw: size: 8.5x.75"; wgt: 0.5 oz; capacity: 40 gal.
AccuFilter Mini Straw	\$10	Bottle: size 10x2.75"; wgt: (filter only) 2 oz; capacity 80 gal. Canteen: US military specifications; capacity 20 gal.
AccuFilter 5 Straw	\$20	
AccuFilter Canteen Insert	\$8	
AccuFilter Sport Bottle	\$18	
The Fountain	3-stage \$30	
	5-stage \$50	
(EPA approval pending for 5 stage products)		

## Sweetwater filter

Claims

Eliminates *Giardia*, *Cryptosporidium* and other critical bacterial and protozoal pathogens, pollutants, heavy metals, pesticides, and flavors. Kills viruses when used with the Viral Guard Cartridge accessory. Lighter, more compact and durable than comparable models, and easiest to clean or replace. Filter cartridges will be recycled by the company.

Comments

Recently marketed, well-designed filter at reasonable price. The three major water treatment components--filtration, GAC, and iodine resin attachment--offer broad protection and maximum flexibility. Practical design features like universal bottle adaptor. If filter lives up to its performance specifications, it will prove to be an excellent product. This resin (like the PUR resin) failed to kill all organisms in worst case water (cloudy, cold, highly polluted water). However, standards were met with two passes, or a 30 minute waiting time after passage.

## Accuventure filters

Claims

3-stage filters remove particulate matter, and activated carbon "removes the taste of chlorine, heavy metals, herbicides, pesticides, organic poisons, and other particulate matter causing bad taste, odor, and color." For use in domestic wilderness or hotel travel. 5-stage filters include Penta-pure iodine resin that "kills bacteria viruses and parasites by contact." 3-stage products are designed for use with water having little or no bacterial, viral, or parasitic contamination, whereas the 5-stage products are designed for use with water having suspected or known bacterial, viral, or parasitic contamination. Drink-through products require suction pressure of 1.5 inches of mercury. The design circulates water through resin internally for three minutes to achieve disinfection when ingested.

Comments

These products contain a rational combination of treatment steps in interesting designs. The convenience of drink-through products could become a liability if easy flow is not maintained, requiring high suction pressures. None of these products (except the Fountain) allow disinfection for a group, unless the bottle is shared. Straws have even more limited applications. Filter pore of 4 microns may remove *Giardia* but is borderline for *Cryptosporidium*. The removal of protozoal cysts decreases the need for contact time, since bacteria and viruses can be killed rapidly after contact with iodine resin. The three minute circulation claim is interesting but difficult to imagine. Since water is ingested directly from the filter, data must prove that contact time and iodine residual are not necessary. The 3-stage filters could be used for North American alpine water in combination with halogens. These products could be very useful for day hikers and bikers who want to carry only a water bottle or canteen.

<u>Product</u>	<u>Price</u>	<u>Structure/Function</u>
Polar Equipment 12881 Foothill Lane Saratoga, Ca. 95070		Iodine crystals, 8 gm in 3 oz bottle; 30-50 micron fabric prefilter provided; "trap" in bottle to catch crystals when pouring off water; bottle cap is used to measure; directions and color dot thermometer on bottle (temperature affects iodine concentration in bottle); capacity: 2000 quarts; wgt: 5 oz.
Polar Pure	\$9	
Polar Pure Plus (new product in development)		2 oz plastic dropper bottle of concentrated iodine/alcohol solution; thermometer and graph for determining dosage and contact time.
Potable Aqua 50 tablets (sold widely in camping stores)	\$5	Iodine-containing tablets (tetraglycine hydroperiodide) release approximately 7-8 mg iodine when added to water. One tablet is added to one quart of water. In cloudy or cold water, add two tablets. Contact time is only 10-15 minutes in clear, warm water, much more in cold, cloudy water (refer to table). wgt: 2 oz. Neutralizing tablets contain ascorbic acid.
with P.A. Plus Neutralizing tablets	\$8	
Emergency Germicidal Drinking Water Tablets are identical to Potable Aqua		

Polar Pure, iodine crystals

Claims

Destroys all waterborne pathogens; yields 4 ppm iodine when appropriate dose is added to one quart of clean water.

Comments

Extensive data exists for effectiveness of iodine (see text). Saturated aqueous solution of crystalline iodine is an excellent source of iodine solution. Recommendations are adequate for clear, warm water; but extend contact time to 1-2 hours for very cold water. Product recommendations is to warm water to 20C (68F) before adding iodine to shorten contact time--but this may not be feasible. Temperature of the bottle affects the concentration of iodine in the saturated solution, which is the reason for the color-dot thermometer on the bottle. Users can adjust the dose according to the temperature, or put the bottle in an inner pocket to warm the solution prior to use. Glass bottle can break. Polar Pure Plus uses valid disinfection chemistry to determine the minimal dose necessary for chosen contact time. This allows control over dose and taste, but requires some intelligence in the user.

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Potable Aqua/EDWGT iodine tablets

Claims

Kills bacteria, viruses, and protozoan cysts, including giardia.

Comments

Method developed by the military for troops in the field. Good data for effectiveness of iodine at these concentrations. Advantages of unit dose and short contact time, but these concentrations create strong taste that are not acceptable to many wilderness users. Options to improve taste include adding one tablet to two quarts of clear water to yield about 4 mg/L (and extend contact time), or use the neutralizer tablets. In cloudy water, use one or two tablets per quart (better yet, clarify water first). Ascorbic acid (vitamin C) neutralizer reduces iodine to iodide, which has no color or taste and has no disinfecting action. Esthetically, iodine is "removed" from the water. However, iodide is physiologically active, so concerns about toxicity or physiologic activity remain. In most situations and for most people, iodine is safe and removing the taste is a major benefit.

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<u>Product/Manufacturer</u>	<u>Price</u>	<u>Structure/Function</u>
Sanitizer (Formerly Sierra Water Purifier) 1430 Wilamette Suite 237 Eugene OR 97401		Chlorine crystals (calcium hypochlorite) and 30% hydrogen peroxide in separate small plastic bottles with dropper and scoop. Uses very high concentrations of chlorine for disinfection, then dechlorinates with peroxide, which causes formation of soluble calcium chloride (non-toxic). Excess peroxide bubbles off as oxygen. Total weight: 5 oz; treats 160 gallons
Available from: Chinook Medical Gear (800) 766-1365		
Or mail order from: Wilderness Mountain Outfitters 513 West Cordova Rd Santa Fe NM 87502 Attn: Randy		
The Sanitizer		treats 720 gallons
starter kit (hikers)	\$13	
marine and RV kit	\$15	
Refills available at reduced price		

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Safesport Manufacturing Co Box 11811 Denver, CO 80211 800) 433-6506		Tablets contain alum as flocculating agent and 1.4% available chlorine in the form of sodium dichloro-s-triazinetriene; bicarbonate causes tablet to dissolve rapidly; cloth provided for simple straining of flocculation sediment; 30 tablets individually sealed in foil packets; wgt 1.6 oz.; capacity: 30 L (8 gal).
AquaCure	\$7.95	

### The Sanitizer chlorination/dechlorination

#### Claims

Kills all microorganisms, except current data indicates *Cryptosporidium* is highly resistant to halogens. Voluminous experimental evidence exists for efficiency of chlorination, especially with use of high concentrations. Hydrogen peroxide is also a weak disinfectant. Treated water has no chlorine taste; in fact, taste is improved from oxygenation.

#### Comments

Sound use of chlorination and dechlorination. Minor disadvantage of two-step process. Peroxide is titrated to estimated amount of chlorine; measurements do not need to be exact, but takes some experience to balance the two and achieve optimal results. 30% peroxide is extremely corrosive, and burns skin, so use cautiously. Very good technique for highly polluted or cloudy waters and for disinfecting large quantities. By far the best technique for storing water on boats: high level of chlorine prevents growth of algae or bacteria during storage, then water is dechlorinated in needed quantities when ready to use. Unfortunately, the resistance of *Cryptosporidium* now leave a gap in the coverage of halogens. High levels of chlorine for prolonged periods may prove effective, but current data is lacking. Further data is also needed on the risk of illness from *Cryptosporidium*.

This product is manufactured and marketed by a cottage industry and is very difficult to find.

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### Safesport Aquacure chlorination/flocculation tablets

#### Claims

Flocculates and yields 8 mg/L free chlorine that "clarifies and disinfects polluted water." Removes silt, organic matter and microscopic particles from water within minutes. Effective against waterborne disease causing organisms, including protozoa, bacteria, viruses and shistosomes. Product information recommends 7 min contact time for warm water, 15 minutes for water below 15C (58F); two tablets for very cold water (one is sufficient but needs longer contact time).

#### Comments

Interesting combination developed for the military in S. Africa and approved for similar use in U.S. In clear alpine water, yields unpleasantly high chlorine levels and creates sediment. Excellent product for cloudy, colored, unpleasant smelling and tasting water. Alum is a widely used flocculant causing suspended sediment, colloids and many microorganisms to clump, settle to the bottom and be readily filtered or strained out. Some chlorine, but hopefully not all, reacts with contaminants and is inactive. It is important to confirm some chlorine taste and smell at the end of the contact time. For added safety, prolong the contact times.



<u>Product/Manufacturer</u>	<u>Price</u>	<u>Structure/Function</u>
Aquaclear Imported by BCB Survival Equipment 7907 NW 53rd St Suite 310 Miami Fl, 33166 (305) 599-4929		Each tablet contains 17 mg sodium dichloroisocyanurate (NaDCC) in paper/foil laminate. Effervescent tablet dissolved in one liter of water releases 10 mg of free chlorine (HOCl), with 50% available chlorine in compound, released as free chlorine is used up by halogen demand. Also available in 340 mg and 500 mg of NaDSS and in screw cap tubs.
Gal Pharm Ltd. Ireland		
Aquaclear 50 tablets	\$5.00	

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Nutrabioc  
865 Parallel Dr  
Lakeport, CA 95453  
(800) 225-4345

Traveler's Friend	\$6	extract from citrus seeds in 10 ml plastic dropper bottle; size: 1x2"; wgt: 1 oz; capacity: approx 20 qts.
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Micropur tablets not sold in US; marketed by Katadyn in Europe, England, Australia	Silver tablets in individual bubble packing; add one tab to one quart of water. Mix thoroughly and allow 2 hours contact time.
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AquaclearClaims

Extensive data for disinfection capabilities of free chlorine. Can use to wash fruits and vegetables in concentrations of 20 mg/L. Surface water disinfection of clear water accomplished at 10 mg/L in 10 minutes, 1 mg/L for tap water and 2-5 mg/L for well water. Test data shows that NaDSS is a stable, nontoxic chlorine compound that forms a mildly acidic solution, which is optimal for hypochlorous acid, the most active disinfectant of the free chlorine compounds. Free chlorine is in equilibrium with available chlorine that remains in compound, providing greater biocidal capacity. NaDSS is more stable and provides more free, active chlorine than other available chlorine products for water disinfection.

Comments

Excellent source of chlorine for water disinfection. Availability of larger concentration tablets allows for disinfection of large quantities of water or for shock chlorination of tanks and other storage systems.

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Nutrabiologic Traveler's FriendClaims

"All natural treatment for drinking water." Non-toxic, non-corrosive, proven effective as disinfectant for bacteria, viruses, protozoa. Recommended dose (drops/qt): 5-10 for filtered water, 10-15 for ice water, 10-20 for tap water, 15-25 for untreated water. Allow 30 minutes contact time.

Comments

Citrus extract is known to have some bacteriostatic effect. This product was introduced in the health food market and is now looking for a broader market. Company data from independent labs support bacteriocidal and virucidal effects. However, protozoal tests were done with trophozoites, not cysts. The data has gaps and too much of the marketing is testimonial to give a recommendation now. The chemical species or compound responsible for disinfection needs to be identified, then dose/time disinfection values experimentally established for various microorganisms.

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Micropur tabletsClaims

"For the disinfection and storage of clear water." "Reliably kill bacterial agents of enteric diseases but not worm eggs, ameba, viruses." "Neutral to taste, simple to use and innocuous." Treatment of water will ensure protection against reinfection for 1-6 months.

Comments

Note that no claims for viruses and protozoa, because concentrations may not be adequate to kill these organisms. Silver has the advantage of having no taste, color or smell. Although proven antibacterial effects, silver tablets are not licensed for use in the U.S. because of the difficulty controlling the residual concentration and the concern over chronic effects. But they are widely used in Europe.

<u>Product/Manufacturer</u>	<u>Price</u>	<u>Structure/Function</u>
Global KDF	\$20	Wand with brush-like zinc and copper alloy bristles that is stirred in the water to dechlorinate or deiodinate. Intended to be used after halogen disinfection; zinc reduces free chlorine to chloride or iodine to iodide via an electrochemical reaction, removing taste of either disinfectant. Size: length 7.5" x 0.75" dia. wgt: 3 oz.
Cl-->OUT dechlorinator (same product) recently off market		

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Global KDF, Cl-->Out

Claims

Electrochemical oxidation technique "removes" free chlorine or iodine, eliminating taste. Will remove 10 mg/l chlorine in 250 cc after 1 minute. Also removes or reduces dissolved metals like copper and heavy metals like lead, selenium and mercury. Zinc acts as catalyst and is not used up: the lifespan of the product is indefinite. Bristles darken as they oxidize, but the reaction is faster, not slower.

Comments

Disinfection relies on prior halogen use. Fascinating chemical process in a simple, compact product for field use. Halogens are not removed, but are neutralized by conversion of chlorine to chloride or iodine to iodide, which have no taste or smell. Chloride is harmless; iodide retains physiologic activity, thus does not eliminate concerns of toxicity or long-term effects. The device will dechlorinate only small amounts at a time; larger volumes or higher concentrations require a considerable amount of time.

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Friday, August 11, 1995

**LEAVE NO TRACE:  
HOW NOT TO BE A  
DISEASE VECTOR**

*NOLS*

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## Leave No Trace: How Not to be a Disease Vector

### Objectives:

- To educate the participants on the principles and practices of Leave No Trace outdoor recreation.

Leave No Trace is a national program designed to provide all non-motorized recreationists with the techniques and ethics to make better minimum-impact decisions while they enjoy their outdoor pursuits.

The national Leave No Trace program is an educational partnership between the US Forest Service, Bureau of Land Management, National Park Service, US Fish & Wildlife Service and the National Outdoor Leadership School (NOLS).

*A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise.*

*Aldo Leopold, A Sand County Almanac (1949)*

Forester and philosopher Aldo Leopold expressed this sentiment in the 1930s. Today increasing numbers of backcountry visitors are coming to the same realization as they witness their favorite wilderness haunts being loved to death by recreationists seeking adventure and solitude. This information is part of a national educational program called Leave No Trace, whose mission is to educate wildland user groups, federal agencies and the public about minimum impact camping. But the principles and practices discussed here are meaningless as a set of rules and regulations unless they are based on an abiding respect for and appreciation of wild places and their inhabitants. Only then can these principles be tempered with the judgment necessary to apply them in the myriad of circumstances in which we find ourselves every time we venture beyond the trailhead.

Since 1965, the National Outdoor Leadership School has pioneered the teaching and development of practical conservation techniques designed to minimize impact. These conservation practices are now incorporated into the national Leave No Trace education program as the following Leave No Trace Principles:

### Principles of Leave No Trace

- Plan Ahead and Prepare
- Camp and Travel on Durable Surfaces
  - Pack It In, Pack It Out
- Properly Dispose of What You Cannot Pack Out
  - Leave What You Find
  - Use Fire Responsibly

These principles are recommended as a guide to minimizing the impact of your backcountry visits. This paper discusses factors to consider under each principle when making judgments about how to minimize impact and the rationale behind recommended practices. Before traveling into the backcountry, we recommend that you check with local officials of the Forest Service, Park Service, Fish and Wildlife Service, Bureau of Land Management or other managing agency for advice and regulations specific to the area.

Leaving no trace depends more on attitude and awareness than on rules and regulations. Low impact camping practices must be flexible and tempered by judgment and experience. Consider the variables of each place—soil, vegetation, wildlife, moisture level, the amount and type of use the area receives and the overall effect of prior use—then use these observations to determine which practices to apply.

### **Plan Ahead and Prepare**

Unnecessary impact in backcountry areas can be avoided by carefully preparing for your trip. For example, if backcountry users do not have the proper clothing to stay warm and comfortable in an unexpected snowstorm they may be forced to build large highly impacting fires in areas where they should not be built.

Taking time to think about what you expect from your trip will help you prepare for it. If you know the area you are visiting is remote and sees few visitors then you should be prepared to camp in pristine areas and practice stringent Leave No Trace techniques. Conversely, in popular highly visited areas you can expect to see more people and should camp in existing campsites. As part of your planning check with the land managers for information and suggestions on your route.

Plan your meals carefully and repack food into reusable containers or plastic bags. This will reduce the amount of trash or litter you bring into the backcountry, and carefully planned rations reduce waste from leftovers.

Taking the proper equipment can help you to Leave No Trace. For example, gaiters that protect your feet and boots will allow you to stay on the main trail when it is muddy from melting snow or rain. Lightweight campstoves and water carrying containers allow the flexibility to camp in the most resistant site available.

### **Camp and Travel on Durable Surfaces**

Wherever you travel and camp, it is best to confine your use to surfaces which are resistant to impact. Such surfaces include trails and established campsites, common in well-traveled areas. In more remote areas snow, rock, sand, pine needles or resilient plant species are more durable.

### **In popular areas, concentrate use**

When in popular or high-use areas it is best to concentrate activity within well-established campsites and trails. These campsites and trails have been "hardened"

and continued use causes little additional impact. Confining use in this way preserves the natural condition of the larger surrounding area.

#### **Minimize impact at the campsite**

Tents, traffic routes and kitchen areas should be confined to already hardened areas or naturally resistant sites. Avoid enlarging established sites or developing new satellite use areas. Wear soft-soled shoes around camp.

Rodents and scavengers create a real mess when they chew into your food supply. Hang your food at least a few feet off the ground at established sites. This prevents habituating these animals to human food sources. In bear country, remember to check with land managers regarding proper food storage.

#### **Respect other visitors' desire for solitude**

Care is required to minimize disturbance to other visitors when traveling in the backcountry. Infrequent contact with other people, small party size and unobtrusive behavior all enhance the feeling of solitude.

#### **Let stock know you're there**

When you meet horses, mules or other stock on the trail, allow them plenty of room. The entire hiking party should move off to the same side of the trail, downhill if possible, and talk quietly until the animals pass. Talking to riders as they approach gives their animals advance notice of your presence and reassures them you are human, despite your towering backpack.

#### **In remote areas, spread use**

Remote or pristine areas show little sign of human use. Often these "cross-country" areas require travel off of maintained trails. Visit pristine areas only if you are committed to and knowledgeable of the techniques required to Leave No Trace in that particular area. If in doubt, stay on maintained trails.

#### **Avoid Places Where Impact Is Just Beginning**

Most campsites can recover completely from a certain level of use. However, a threshold is eventually reached where the regenerative power of the vegetation cannot keep pace with the trampling. Once this threshold is reached the site will deteriorate rapidly with continued use. This will result in the development of an campsite with a discernible "barren core." The threshold for a site is affected by many variables, including vegetation type, soil fertility and length of growing season.

#### **Pack It In, Pack It Out**

Pick up and pack out all of your litter. Burying or leaving trash and litter in the backcountry is unacceptable. On the way out—when your pack is light—try to pick up litter left by others.

Reduce litter at the source. When preparing for your trip, repackage food into reusable containers or remove any excess unnecessary packaging.

Food scraps should be picked up from the kitchen area and packed out. Careful planning will reduce leftovers, but in the event you have some it should be either saved and eaten later or put in a container and packed out. Burning and burying this type of waste requires a very hot fire to burn thoroughly, and animals will dig it up if buried. Consider the words "Leave No Trace" a challenge to take out everything that you brought into the backcountry.

### **Properly Dispose of What You Can't Pack Out**

Visitors to the backcountry create certain types of waste which cannot be packed out. These include human waste and waste water from cooking and washing.

Proper disposal of human waste is important to avoid pollution of water sources, avoid the implications of someone else finding it, minimize the possibility of spreading disease and maximize the rate of decomposition. Burying human feces in the correct location and manner is the most effective method to meet these criteria.

Catholes are the most widely accepted method of waste disposal. Locate catholes at least 200 feet from water, trails and camp. Two hundred feet is about 70 steps for an adult. Select a site which is inconspicuous, where other people will be unlikely to walk or camp. With a small garden trowel dig a hole 6-8 inches deep. When finished, the cathole should be covered and disguised with natural materials. If camping in the area for more than one night or if camping with a large group, cathole sites should be widely dispersed.

Use plain, white, non-perfumed toilet paper sparingly. It should be thoroughly buried in a cathole or placed in plastic bags and packed out. When done correctly, "natural" toilet paper is as sanitary as regular toilet paper, but without the impact problems. Popular types of natural toilet paper include stones, vegetation and snow. Some experimentation is necessary to make this practice work for you.

Soap is unnecessary for most dish washing jobs. It is difficult to rinse thoroughly and introduces unnatural chemicals to the backcountry. Hot water and elbow grease can tackle most cleaning chores. Waste water should be scattered over a wide area away from camps and all water sources. Remove food particles from the water before disposing of it and pack them out with other litter. If you are in bear country or expect to create large amounts of waste water, it may be best to concentrate it in a sump hole.

The primary consideration when washing yourself or your clothes is to avoid contamination of water supplies. Soap must not enter lakes or streams, so it is best to minimize its use. If bathing with soap is necessary, get wet, lather up on shore far from water (200') and rinse with water carried in a pot. This procedure allows the biodegradable soap to break down and filter through the soil before reaching any



body of water. Clothes can be cleaned by thorough rinsing. Soap is not necessary and residual soap can cause skin irritation.

### **Leave What You Find**

Allow others a sense of discovery by leaving rocks, plants, archaeological artifacts and other objects of interest as you find them.

On all sites, leave the area as you found it. Do not dig trenches for tents or construct lean-tos, chairs or other improvements. On high impact sites, it is appropriate to clean up the site and dismantle inappropriate user-built facilities, such as multiple fire rings and constructed tables. Consider the idea that good campsites are found and not made.

Take a picture or sketch flowers instead of picking them. Enjoy an occasional edible plant, but be careful not to deplete the surrounding vegetation or to disturb plants that are either rare or do not reproduce in abundance. In National Parks and some other areas it is illegal to remove natural objects.

Cultural artifacts found on public land are protected by the Archaeological Resources Protection Act, and it is illegal to remove or disturb artifacts from *any* public lands. This act protects all artifacts ranging from seemingly insignificant potsherds and arrowheads to ornate pots and clothing items.

### **Use Fire Responsibly**

The use of campfires is steeped in history and tradition. This tradition is so entrenched that for some the thought of going on a backcountry trip and not having a fire is almost unthinkable. However, a new attitude is developing toward campfires. This attitude is a result of the past misuse of campfires and the scars caused when fires are built incorrectly.

Fires vs. stoves. Though cooking on a fire is a skill and an art, backcountry visitors should not embark on a trip intending to do all cooking on fires. A lightweight gas stove is essential equipment for any overnight backcountry trip, no matter how long or short. Stove use for cooking allows the greatest degree of flexibility in selecting a low-impact campsite.

The most important factors in determining whether or not to have a fire are:

1. The availability of the right amount and type of firewood
2. Wind conditions and overall fire danger
3. Administrative restrictions.

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**Friday, August 11, 1995**

**WHAT'S NEW IN  
DIVING MEDICINE**

*Eric Johnson, MD*

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WHAT'S NEW IN DIVE MEDICINE

Workshop for the WMS World Congress, Aspen '95

Presented by: Eric Johnson, M.D.

Idaho Emergency Physicians  
Boise, Idaho

Objectives:

- 1) Understand basics of dive physiology.
- 2) Discuss updated thinking in bubble formation and dive pathophysiology.
- 3) Review diagnosis and treatment of dive injuries.

This workshop will review basics of dive physiology and dive-related injuries. Will discuss new thinking and controversies in bubble formation and its relation to pathophysiology. Also intend to review common dive-related injuries and current treatment of such. This workshop will be classroom style with open discussion and is available for all levels of diving and for those who wish to learn about dive medicine.

Handouts will be available at the workshop and are not included in this syllabus to allow the "latest" information to be discussed.

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Friday, August 11, 1995

**THORACIC AND  
ABDOMINAL INJURIES  
IN THE FIELD**

*Bruce Paton, MD*

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## CHEST AND ABDOMINAL EMERGENCIES

Dr. Bruce C. Paton  
Clinical Professor of Surgery  
University of Colorado

### OBJECTIVE:

The objective of this talk is to review the diagnosis and field management of chest and abdominal emergencies - both traumatic and non-traumatic. Symptomatology, physical signs and differential diagnosis will be stressed. Discussion of treatment will be limited to treatment possible in the field.

**BASIC QUESTIONS:** - 1. "Is the problem getting better, worse, or staying the same?". 2. "Evacuate or not evacuate?"

## THORACIC EMERGENCIES

The management of chest problems in the wilderness is obviously very different from management in the office or hospital. X-rays are not available and diagnosis depends on history and physical findings.

**HISTORY:** a) Onset of symptoms - no problem if the symptoms follow an injury. If the traveler has developed pneumonia, pleurisy, a lower or upper respiratory tract infection, several days may elapse between exposure and symptoms, that may develop over hours or days.

b) **Symptoms:** The three most common symptoms are PAIN, COUGH, SHORTNESS OF BREATH.

There are 11 questions to ask about ANY PAIN:

\* 3 questions about location:-

1. Where is the pain(including depth)? - front, back etc.
2. How large an area is involved? - finger tip, hand-sized.
3. Does the pain radiate?

\* 3 questions about time and duration:-

1. Duration;when did the pain start?
2. Frequency?
3. Special times of occurrence?

\* 2 questions about the nature of the pain:-

1. Severity? Grade 1-10
2. Character? Burning, stabbing, crushing

\* 3 questions about associations

1. What makes it worse?
2. What makes it better?
3. Any associated symptoms? Cough, nausea, shortness of breath.

**COUGH:** Consider the circumstances under which the cough starts. Has there been exposure to obvious sources. In Nepal, for instance, cough is extremely frequent in trekkers due to bronchitis picked up in the villages, or in close associations with charming, but snotty nosed children. At what altitude did the

cough start? If the person has been well until reaching 12,000ft then begins to have a dry cough associated with increasing shortness of breath - the problem should be considered altitude related.

Is there associated fever? Most cases of altitude sickness do not have fever.  
Is there sputum? What does it look like?

**SHORTNESS OF BREATH:** An extremely important symptom. Rapidly worsening shortness of breath, respiratory effort, cyanosis and increasing anxiety in the patient are signs of impending disaster. (see below ; assessment)

Is the shortness of breath appropriate to the environment and conditions. Everyone becomes short of breath with increasing altitude, but is the person unduly short of breath and more short of breath than others in the group. Is this associated with a new cough? If you are over 8000ft, start thinking about HAPE.

Are there any cardiac symptoms or a history of cardiac problems?

**PHYSICAL EXAMINATION:** the time honored principles of physical examination are crucial; inspection, palpation, auscultation and percussion.

**INSPECTION** - nature, rate and adequacy of respiration and ventilation, symmetry of chest movement, obvious injury. Don't forget to turn the patient over and look at the back; opening the shirt and looking only at the front of the chest is not enough.

**PALPATION:** Is movement symmetrical? Place both hands on the front of the chest, one on each side, and compare movement. From the back, place both hands around the chest and compare movement. Is there any flail(part of the chest wall moving out when it should be moving in)? Feel the trachea in the suprasternal notch. Is it in the midline or deviated to the side? Deviation to one side indicates a problem on the opposite side - pressure, fluid, air.

Feel the pulse - rate, rhythm, strength. A person may become short of breath because they have developed atrial fibrillation (not uncommon at altitude).

**AUSCULTATION:** If you do not have a stethoscope, you can still hear breath sounds by placing your ear directly on the chest. Or improvise a stethoscope; listen through a roll of paper. Listen to the heart - rhythm and murmurs

**PERCUSSION:** Practice percussing chests. This enables you to tell the difference between fluid and air - and you don't need a stethoscope.

\*\*\*In hospitals the symbol and sign of a doctor or a nurse is frequently a stethoscope hanging around the neck, showing our reliance on the stethoscope as the only means of examining a chest - short of Xrays, CAT scans and MRI. Few people take a stethoscope into the wilderness. Without a stethoscope, but with a good history and the use of other means of physical examination, many acute thoracic problems can be diagnosed.

## **THINK ABOUT THESE PROBLEMS -**

**NON-TRAUMATIC :** Respiratory ; bronchitis, pneumonia, pleurisy and pleural effusion, HAPE, spontaneous pneumothorax, asthma

Cardiac - changes in rhythm, paroxysmal tachycardia, myocardial infarction, pericarditis.

## **TRAUMATIC:**

A. Closed injuries : blunt crushing injury may cause pulmonary hematoma, fractured ribs, with underlying pulmonary injury from rib ends. Laceration of lung surface may lead to tension pneumothorax, hemothorax, hemo-pneumothorax. Flail chest, from a massive fall with the fracture of several ribs on the same side, results in an unstable chest and impaired ventilation:

Rx - stabilize flail with dressing, bandage, tape; infiltration with local

anesthetic may reduce pain, increase ventilation.

Endotracheal intubation and insertion of chest tubes is an extremely unlikely possibility in the wilderness. But tension pneumothorax can be relieved with a standard hypodermic needle(see below).

On a major expedition endotracheal tubes, Heimlich valves and equipment to tap a chest might be available. If you are an expedition doctor make sure you are familiar with this equipment and how it is used before embarking on the trip.

**B. OPEN INJURIES:** Sucking wounds result in major disturbance of ventilation. Small penetrating injuries may not cause serious trouble if the opening seals immediately: Rx - large air-tight dressing; stabilize chest movement.

**C. TENSION PNEUMOTHORAX.** Cause - a valve laceration on the surface of lung: increasing pressure in pleura: hollow sound on percussion:trachea deviated away from side: increasing SOB : Rx - immediate relief of tension by insertion of a needle into an upper anterior interspace. Relief of tension is the primary aim. Expansion of the lung can come later.

**D. CARDIAC INJURIES** Any major injury involving the thorax may result in cardiac injury. Deceleration injuries, such as a fall from a height, or an automobile accident can result in injury to the thoracic aorta. This is virtually impossible to diagnose in the wild. If there is severe bleeding, the victim will probably die before help can be reached. In traumatic aortic rupture 20% die at the scene of the accident.

Myocardial contusion may be trivial and pose not problem, or may be similar in severity and symptoms to a myocardial infarct.

#### **ASSESSMENT:**

1. Is the airway open? Look for mechanical obstruction from foreign material, vomit, blood,etc.
2. Is ventilation adequate? Are both sides of the chest moving? Are they moving symmetrically, or is only one side moving? Is there any flail?
3. If only one side is moving - what is the problem with the non-moving side? Air under tension, blood, pleural effusion, fractured ribs causing pain and splinting?
4. What can you do to make the patient more comfortable and improve breathing? Will relief of pain without suppression of ventilation improve things? Can the patient tolerate restriction of ventilation and still be OK? Can you tape the chest and stabilize fractured ribs,etc?
5. Has there been blood loss and is the patient likely to develop hypovolemic shock?
4. Is the patient getting better, worse or staying the same?

#### **GENERAL PRINCIPLES OF CARE:**

1. Maintain airway.
2. Start mouth-to-mouth, prn.
3. Place patient in most comfortable position - frequently sitting up.
4. Stabilize ventilation - dressing, position. If one side only is not ventilating -breathing may be easiest with patient lying on the injured side.
5. Stabilize protruding foreign bodies - do not remove.
6. Control external bleeding with pressure.
7. Observe frequently. Record vital signs.
8. Give antibiotics, if available, for all open wounds. Treat respiratory infections with appropriate (or available) antibiotic.
9. On high altitude expedition, have Gamow bag available - both for HAPE and closed injury with distress in whom 'descent' might improve condition.
10. Evacuate or don't evacuate?

### **WHEN TO EVACUATE:**

1. All penetrating injuries
2. All injuries with ventilatory instability
3. Probable pneumothorax, hemothorax, pleural effusion
4. All patients who are becoming worse - increased pain, shortness of breath, changing color (lips, nail beds), increasing cough with ascent to higher altitude.
5. All rib fractures with obvious 'grating' - danger of lung damage
6. Closed trauma with hemoptysis
7. Pulmonary infections with increasing fever, cough, clinical signs of pleurisy

### **POSSIBLE REASONS NOT TO EVACUATE:**

1. Single rib fracture, point tenderness, no respiratory instability or distress.
2. Mild possible HAPE at moderate altitude, stable; circumstances permit waiting without further ascent; observation and later evacuation possible if condition worsens. Safer if oxygen or Gamow bag available.
3. Pulmonary infection obviously getting better; decreasing fever and cough; no pleuritic pain;

## **ABDOMINAL EMERGENCIES**

### **SYMPTOMS:**

The most common symptom of an abdominal emergency is PAIN.

Abdominal pain is of two types - visceral and somatic.

VISCERAL PAIN: is transmitted through the autonomic/sympathetic system.

Pain is caused by distension or spasm of the smooth muscle of the gut, and is frequently felt as colic. Localization is not precise, but pain arising in the upper stomach and upper small intestine is often epigastric, mid-gut pain is periumbilical and large bowel pain is lower abdominal. The pain is deep.

SOMATIC PAIN is caused by irritation of the somatic nerves from T7-L1 that supply the abdominal wall, including the peritoneum. Irritation of the under surface of the diaphragm is referred to the tip of the shoulder. Typically, the pain is superficial, easily localized to a specific point or area of the abdominal wall. The peritoneum may be irritated by external factors in the abdominal wall or by internal irritants such as peritonitis, the rubbing of an ischemic gut against the abdominal wall, free blood or feces in the peritoneal cavity.

### **ABDOMINAL ILLNESS**

1. RENAL CALCULUS : Very severe pain, starting in the flank and radiating forwards and downwards to inguinal region, scrotum or labia. Pain: two types. 1) fixed; dull, boring pain in flank, greater during exercise. 2) paroxysmal, colicky, rising to a crescendo lasting some seconds, then decreasing, but not disappearing. Comes on more in exercise than rest. Pain is caused by smooth muscle spasm of the ureter while stone passes from kidney to bladder. After stone has dropped into the bladder, pain stops. Duration of pain varies, depending on the size of stone being passed and ease and rapidity of passage. During spasms the patient writhes in pain, becomes pale, sweats, clasp a hand to the affected side and, if lying down, drawing up the knees. Hematuria, secondary to trauma of stone passage. No fever. Signs:

Treatment: Increase fluids intake to increase urine flow. [Not always a good idea because if the ureter is completely obstructed by the stone, pain may increase] : anti-spasmodic pain medication - demerol, not morphine.

2. APPENDICITIS: Symptoms develop over several hours. In a 'typical' case starts with upper abdominal pain, moving to the right lower quadrant or periumbilical region. Mild fever. Vomiting. Pain is spasmodic. Patient prefers to lie



on the side, legs drawn up. In many cases the pain is constant around the umbilicus. Pain is due to increasing tension within the appendix. Vomiting early, and continuous. Temp. up 1-2 degrees with gradual rise. Chills and rigors are signs of severe trouble. Signs: tenderness, rebound tenderness, localized pain in right lower quadrant. Point of max. tenderness depends on location of appendix.

Differential diagnosis: diverticulitis [more pain on right side], peritonitis [more diffuse pain and more systemic effects]; gastro-enteritis [more diarrhea and vomiting, history of food ingestion, group illness] Treatment: Mortality and morbidity are influenced by perforation; perforation usually occurs after two days; therefore, get person out as soon as possible. In meantime - antibiotics, fluids - a problem - fluids are needed, but given by mouth can increase vomiting, IV fluids may not be available. On big expedition - give IV fluids, antibiotics, position patient in sitting position [to drain possible rupture into pelvic cavity] Peritonitis: caused by perforation of bowel with spillage of bowel contents; or, traumatic perforation. Symptoms: diffuse, increasing abdominal pain due to irritation of parietal peritoneum; pain starts in area of primary infection and gradually spreads over abdomen; total ileus: Signs: patient looks very sick, febrile, face drawn, sweating, rapid pulse and breathing, vomiting, abdo. wall, rigid, motionless, diffuse tenderness.

3. GASTRO-ENTERITIS: Caused by ingestion of contaminated food or water. Symptoms may develop within hours, days, or weeks (giardia) of ingestion. Several members of a group may be affected simultaneously. Preventive cleanliness and care in consumption of food and drinks is important; flies are an important mode of distribution even if the food is prepared carefully.

Symptoms: Sudden onset of nausea, vomiting, belching, diarrhea, abdominal cramps; thirst, weakness and tiredness. Signs: mild abdominal tenderness, dry tongue [if there has been prolonged D & V without adequate fluid intake], Fever may be present with some causes. If traveling in tropical countries, numerous possible causes that require lab diagnosis. Treatment: Maintain fluid intake, p.o. electrolyte replacement solutions prn. Medications to decrease cramps and slow diarrhea [Lomotil, Imodium, codeine] increase comfort, specially if patient is hiking or travel is unavoidable; no evidence that this increases severity of disease.]

4. GASTRIC AND DUODENAL ULCER: Very unlikely that a traveler will develop an ulcer, de novo, on a trip, unless the trip is prolonged. Therefore, only the complications are likely to occur - hemorrhage, perforation, gastric outlet obstruction. Hemorrhage and perforation occur acutely. Obstruction develops slowly over a longer period. Unusual for either hemorrhage or perforation to occur without some previous history suggestive of ulcer disease. a) Hemorrhage - sudden onset of vomiting blood, or passage of tarry stools, accompanied by weakness, rapid pulse and possible evidence of hypovolemic shock, depending on volume of blood loss; usually no specific abdominal signs. b) Perforation - sudden onset severe epigastric pain; patient lies with legs curled up and will not move; board-like abdominal rigidity; Obstruction; slowly increasing vomiting after meals, often vomiting up food eaten a long time before. May be some upper abdominal swelling due to gastric distension. Treatment: a) hemorrhage - immediate evacuation; treat for shock, if present; if increase in ulcer symptoms - start or increase anti-ulcer medication [Tagamet, Zantac etc]; if immediate evacuation impossible - small frequent meals, maintain fluid and electrolyte intake; evacuate as soon as possible. b) Perforation - evacuate a.s.a.p.; pain medication prn; npo; IV fluids if available. Because the peritonitis is mostly chemical, infection is not an immediate problem, but antibiotics, im. or iv, advisable. c) Obstruction - because of the slow onset of symptoms, treatment en route is possible; maintain fluid and electrolyte intake, restrict diet to fluids [easier to pass through scarred duodenum]; evacuate quickly, but not with urgency, unless the pt. is very de-

hydrated and needs IV fluids that you cannot provide.

5. **HERNIA:** An inguinal hernia, per se, should not give trouble. [Before long expeditions inguinal hernias should be repaired, even if not giving trouble] But if it becomes incarcerated [irreducible but not gangrenous] or strangulated [not reducible and gangrenous] a serious problem exists. Symptoms: a) reducible hernia; non painful swelling that comes down intermittently into hernia sack, frequently with increased intra-abdominal pressure. b) Incarcerated; Groin swelling, discomfort, not possible to reduce; no evidence of strangulation or intestinal obstruction. c) Strangulation: painful, tender swelling in inguinal region; nausea and vomiting if intestinal obstruction; evidence of toxemia less than with internal strangulation.

Signs: Non-painful swelling in groin probably due to reducible hernia; the more pain and tenderness, the greater the possibility of strangulation. With strangulation pain may be referred into flank or back.

Treatment: a) reducible; no treatment. b) incarcerated; try and reduce gently, then evacuate. There is a remote possibility that ischemic bowel may have been returned into the abdominal cavity. c) strangulated - evacuation stat.; npo; pain medications, prn.

6. **Intestinal obstruction;** Most likely causes: hernia, adhesions from previous operation, paralytic ileus secondary to peritonitis, (cancer of bowel).

Symptoms: nausea and vomiting, abdominal distension, total constipation, colicky pain. Onset gradual Signs: patient appears ill, rapid pulse, abdo. distended, possible scar from previous operation, loud bowel sounds - unless paralytic - but may disappear after 24 hours as bowel becomes so distended that intestinal action ceases.; pain and tenderness may be mild at first, but signs of peritonitis later.

Treatment: Immediate evacuation; keep npo; pain medication prn

## **ABDOMINAL INJURIES:**

Essential questions: How severe? How sick? Evacuate or not?

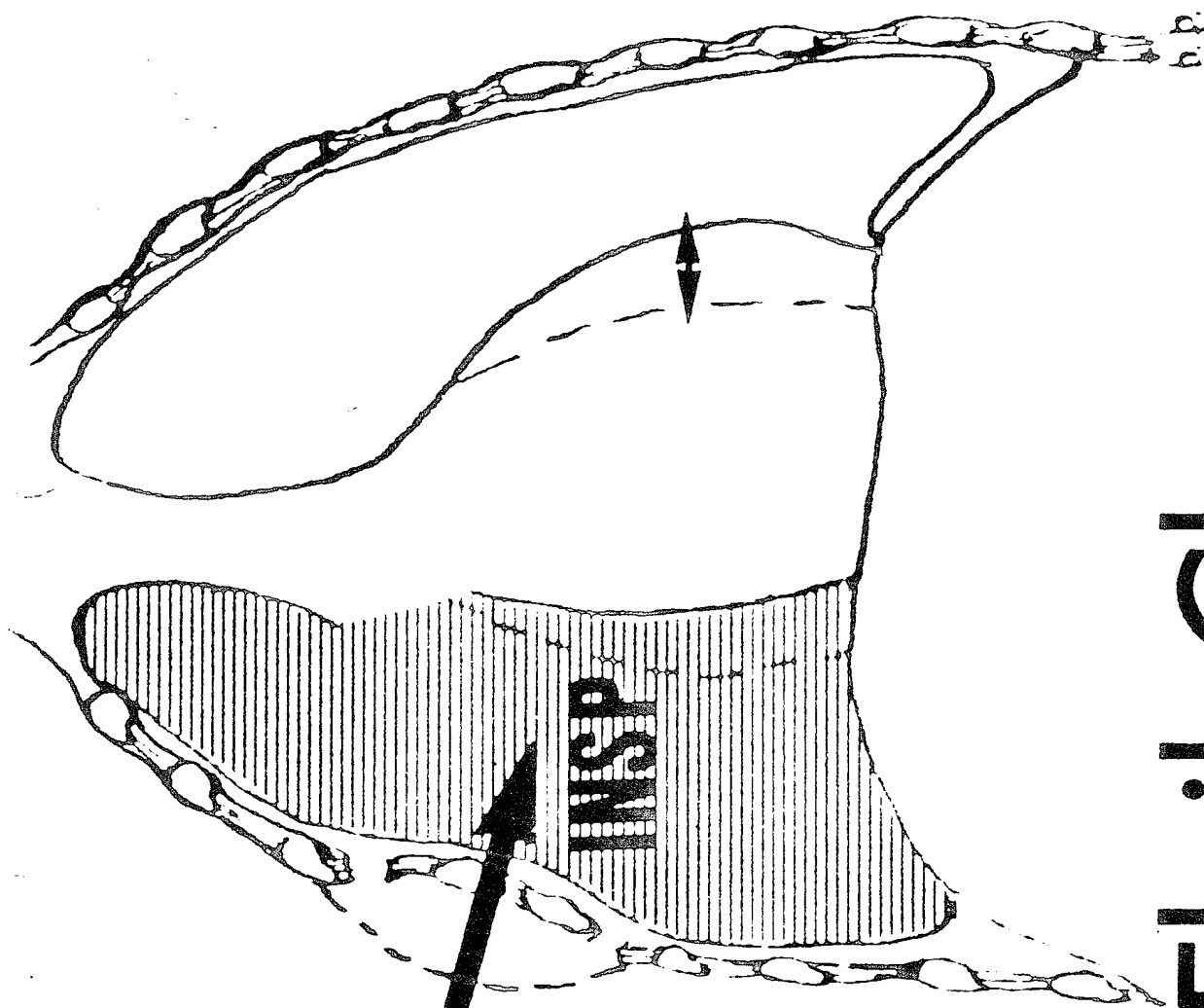
History: Determine cause of injury, type of injuring object - ice-axe, rock, branch of tree, etc - time since injury, changes in patient's condition since injury, associated symptoms [hematuria, vomiting, blood in stool, etc]

BLUNT INJURY: 1) abdo. wall contusion 2) internal bleeding 3) rupture of organ 4) combination of above.

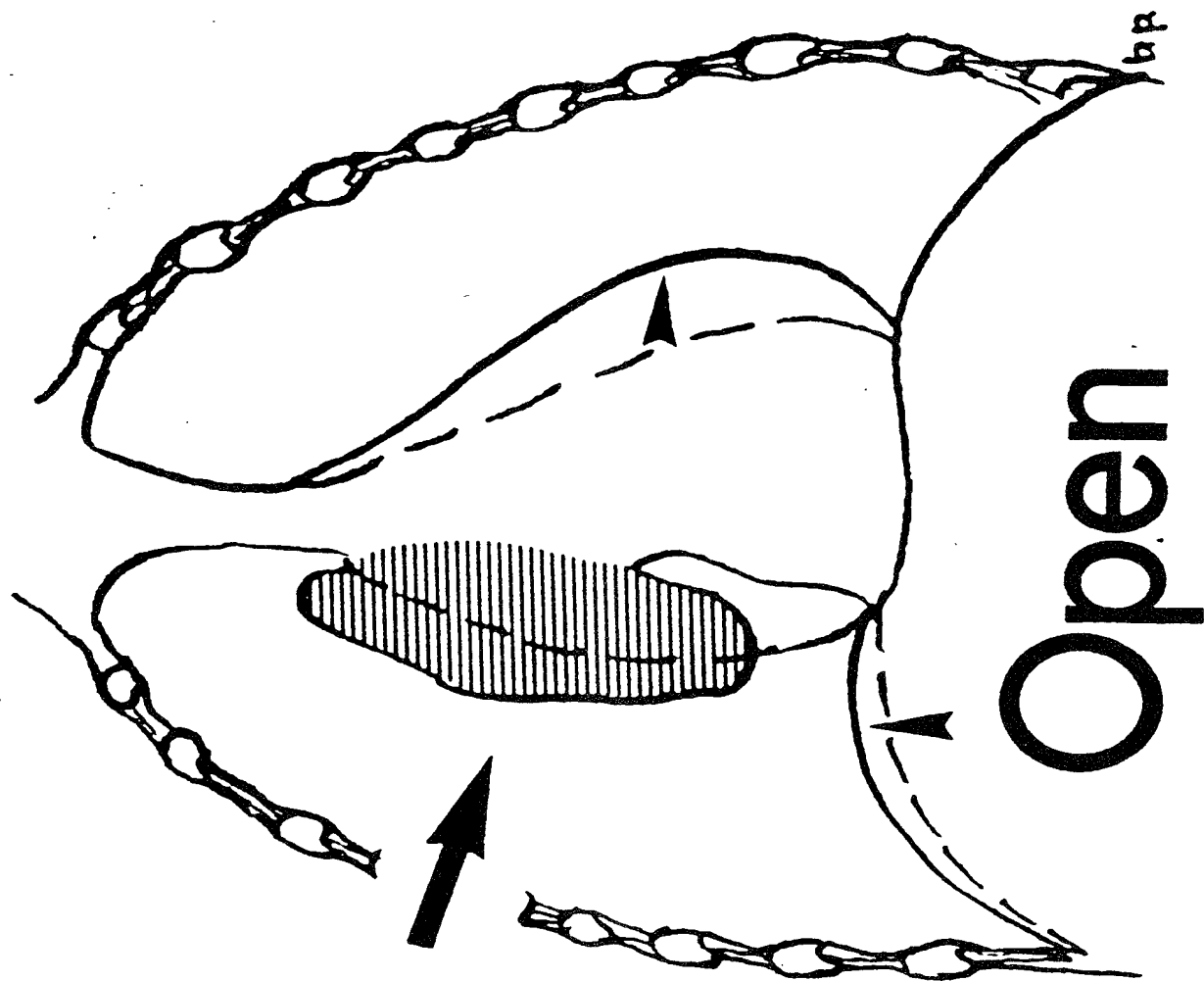
1) Contusion ; local pain, but no generalized pain; diagnosis made after delay; if pain becoming worse - probably internal injury. Observe carefully, mild pain meds. 2) Internal bleeding - rupture of spleen, liver, kidney, rarely intestine. Blow directly over organ. Blood in peritoneum causes pain, local at first, but spreading with flow of blood; shock with increasing blood loss; Bleeding from spleen and liver seldom stops without operation. 3) Rupture of organs: blow in RUQ - suspect liver; in LUQ or flank- suspect spleen; suspect kidney if blow in either flank. Kidney rupture associated with blood in urine. Most kidney injuries stop bleeding spontaneously and kidney rarely has to be removed. Note Delayed rupture of spleen; blow in left flank, sometimes with broken ribs, no severe immediate symptoms; about one week later, sudden onset of pain and shock. Other organs: bladder, intestine. Signs of peritonitis - intestinal contents or urine. Treatment: Evacuation, except in mildest cases; treat shock.

PENETRATING INJURIES: Very serious; immediate evacuation and surgery mandatory. . Diagnosis - usually obvious. Not all injuries that penetrate the skin and muscles penetrate the peritoneum - but **DO NOT POKE AROUND!!** Treatment: Place sterile dressing over wound. Loops of bowel - clean with as sterile technique as possible and push back into abdomen. If not possible to return to abdo. keep moist and sterile/clean.

**EXP**



**Flail Chest**



# Pneumothorax

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Friday, August 11, 1995

# SAR DOGS

*Carla Tomaszczyk, EMT-D, et. al.*

## SAR Dogs and Their Function

Tomaszczyk, et. al.

SAR Dog Handlers

Aspen, CO

Following this presentation participants will be able to:

- A. Recognize the value of search dog teams in the field and observe how to work with a search dog team.
- B. Establish how a handler recognizes canine body language and interprets what is so indicated by the visual relationship from dog to handler.
- C. Visualize the dynamics of the environmental effects on scent and the K-9 olfactory sense.
- D. Differentiate variables related to specialized SAR areas: Avalanche, Disaster, Evidence, Water and Wilderness and how these variables relate to K-9 SAR.

Note: This workshop will be both inside and outside. Participants need to wear proper footwear and proper clothing to be able to observe the dogs working in the field. Be prepared to hike uphill and downhill in all types of weather. Thanks.

There are many values that are recognizable when a well trained rescue dog team enters the field. We will concentrate on the three most important. The first and most important is the rapid location of the lost or injured party. A search dog team can cover vast areas that would take other conventional ground teams many hours or days to cover. This savings in time could be the difference in finding the party dead or alive. The second greatest value is the conservation of resources. A search dog team can eliminate areas from the search pattern very rapidly. This can be done by giving the direction of travel from the place last seen by a tracking or trailing dog, or by covering the area with an air scent dog team. The increased probability of detection by search dog teams allows the rescue commander to apply the other resources in a more efficient and effective manner. The third most important value is the savings of funds. By shortening the amount of time spent on searches, SAR dog teams not only save all of us money but can aid in saving lives or allow the surviving members of the family to start healing or begin closure.

To help the search dog teams be as efficient as possible it is important that all members of a rescue team have the basic knowledge of how all types of dog teams work. It is important that a team member has the ability to tell when the dog has made an alert, just in case the handler had to take their eye off of their K-9 partner. All dogs have different ways to communicate what they have or have not found. This communication will be demonstrated in the field session. The importance of a team navigator can not be under estimated. The dog handlers have to keep their eye on the dog as much as possible, therefore they have to rely on the navigator to keep a record of the terrain which they are covering.

When a handler is working their dog they need to observe and interpret the dogs body language. Tail up, tail down, animation vs constant investigation. A good point to understand is each dog is different visually in their alerts to some degree. Such as, some dogs have little or no tail. Some dogs work very quickly while others work more methodically. Usually a SAR dog will start out with a scanning type movement then fine tune to a more purposeful animated type movement. The more observed dog via handler, the more the difference can be seen upon detection. Upon discovery of the missing person many times an exaggerated excitement occurs by the dog, barking, tail wagging, dog grabbing the handler by the hand with its mouth. The dog will often range more ahead of the handler at close to subject discovery due to the higher concentration of scent. Discovery of the subjects scent means reward for the SAR dog.

Often the nonviable subject will be reacted to quite differently by the SAR dog. The scent leading the search changes at the scene. The dog tends to become a bit confused due to the fact it knows the scent leading up to the discovery was correct yet has changed to something else. It is critical for the handler to encourage and reward the dog for the find. Many times this can be upsetting for the people on scene, but it remains necessary to motivate the dog for future finds of this nature. The handler will try to be discrete when this is the case.

The dynamics of the environment on scent and the dogs olfactory sense are at times not very obvious. The environment that surrounds the scent article, whether inside, outside, under water, or suspended in the air have varying effects on how the dog can work the problem. The problem is location of the desired person by the dog. The effects of the sun, wind, humidity, and temperature all add a twist to the dynamics of how scent is dispersed and preserved. The environment also effects the longevity of the scent in any one location. The K-9 team handler must be very concerned with the environmental effects on the olfactory system of their partner. The lack of proper care can result in a drop of the probability of detection or a total no find by the team. It is the job of the handler to know their dogs limits and to protect and enhance their physical abilities to perform the job at hand. Knowing the way the environment manipulates scents and being able to effectively manage all the variables is what makes a good handler great.

The participating members of the workshop will have the opportunity to participate in a field session that will give the basic skills to work with the K-9 search teams. This exercise will allow participants to walk away with a greater knowledge of why K-9 teams can enhance rescue efforts. The environmental effects will be pointed out to increase participants knowledge of just how important interpretation by the handler aids in the discovery of the subject

Finally, the application to all SAR rescue specialties. The disciplines of K-9 SAR are air scent, trailing or tracking. The specialties are avalanche, disaster, evidence, water and wilderness. The dog has learned to play the search game by finding the desired subject and receiving a play session as the reward. Normally, a dog is started with wilderness training then is diversified to a speciality which will be most used in the area of response. The game remains the same. Find the subject and get the reward. The SAR dog learns to find subjects under various elements or above the same. The complicated part of the story is how and where is the scent coming from, the handler aiding dog to best discovery zone. The number one issue, as always, is safety. The handler needs to be well versed in the speciality and the dog needs to be trained to a high degree of confidence. Relating to the complicated travel patterns of scent involved in all categories would require more pages than we are able to print at this time. Simple stupid, understand that scent will escape via the path of least resistance. Application to speciality will vary with the elements involved. The handler must ultimately set the dog up to success by their knowledge of all the pieces of the puzzle available. Our goal is to aid the whole team effort with succeeding in the rescue. The handler is human and the dog is no robot. But with education within the rescue community the effectiveness of this valuable resource will someday be used to full potential.

#### Recommended Readings

Search Dog Training by Sandy Bryson

Training Tracking Dogs by William R. Koehler

Search and Rescue Dogs Training Methods by The American Rescue Dog Association



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Friday, August 11, 1995

**MOUNTAIN RESCUE IN U.S. -  
COMPARISON OF U.S.,  
CANADIAN AND  
EUROPEAN TECHNIQUES**

*Bill Clem, MD*

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**MOUNTAIN RESCUE IN THE UNITED STATES**  
**A COMPARISON OF U.S., CANADIAN AND EUROPEAN TECHNIQUES**  
**Bill Clem, MD, FACEP**  
**National Medical Advisor, Mountain Rescue Association**  
**Golden, Colorado USA**

For many years Mountain Rescue techniques have been proprietary to the country and locale of origin. The tradition of passing rescue techniques from generation to generation has led to inbred techniques steeped in history rather than in documented science. With the advent of information exchange through such media as the International Commission on Alpine Rescue and the North American Technical Rescue Symposium, more emphasis is being placed on engineering studies and testing rather than hearsay and hand-me-downs.

This workshop is a review of the integration of rescue techniques from mountain rescue to cave rescue, from cave rescue to mountain rescue and the spinoffs of swift water rescue and technical urban rescue whose techniques draw heavily from their predecessors. As helicopter rescue has evolved, it too has drawn heavily from mountain rescue techniques, largely due to the influence of mountain rescuers using the helicopter as a tool to perform remote or difficult rescue operations.

In areas of the world where helicopters are readily available for mountain rescue operations, they are heavily used, in lieu of ground based teams. In the United States, unlike Canada, Europe and Great Britain, a lack of government support and an adverse legal environment has served to discourage the use of helicopters in mountain rescue operations. This has led to continuation of a predominantly ground based rescue system with all the accompanying difficulties. We look at the fiscal and logistical aspects of helicopter-based rescue systems and the obstacles facing U.S. teams in implementing such a system.

Following the presentation, the participants should be able to understand the fundamental differences in mountain rescue systems in the U.S., Canada, Great Britain and Europe. In addition, participants should have an understanding of the evolution of rescue concepts and techniques across cultural and national boundaries.

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Friday, August 11, 1995

# **HUMAN PERFORMANCE IN THE WILDERNESS**

*Blair D. Erb, MD*

## HUMAN PERFORMANCE IN THE WILDERNESS

### WORKSHOP #34

FRIDAY AUGUST 11, 1995

BLAIR DILLARD ERB, M.D., FACP

As a result of this session, the participant will:

- 1) Be introduced to the Balke Principle (X-Y Plot)
- 2) Understand the physiologic response to physical workloads.
- 3) Learn to use "BODY SIGNALS" to read response to work load and wilderness ventures.

A wilderness venture can be measured in many ways: As an experience for enrichment, as an art form for beauty, as a challenge for conquest, or as an adventure for thrill. Personal needs, wishes and goals vary widely among participants, but the common denominator for all wilderness ventures is physical activity.

Because of the wide variation in physical tolerance among individuals, the physical demands of a wilderness venture may be too great for some, or boringly simple for others. Hence, it may be prudent to provide not only a narrative description of the component tasks of a wilderness venture, but also the functional capacity of the individual in order that an appropriate match may be made between the individual and the venture.

Measurement of workload and individual response to physical demands can be accomplished technically by using the discipline known as "Work Physiology", defined as the "scientific study of the mechanisms involved in the transformation of chemically bound energy into mechanical energy".

As a clinical discipline, work physiology applies to "the functional state of the individual, to workloads imposed upon the individual, and to factors, such as environment which may influence the response to that workload". (Medical Practice Committee report, American College of Physicians).

#### THE BALKE PRINCIPLE

The body responds to increased requirements by making appropriate internal adjustments. An increase in the intensity of exercise results in an increase in various physiologic parameters including heart rate, blood pressure and respiratory rate.

These observations are fundamental not only in exercise testing, but also in exercise prescription, exercise monitoring and for providing advice in regard to exercise limits, and for planning physical aspects of wilderness activities.

This fundamental observation was developed and taught as THE BALKE PRINCIPLE by Professor Bruno Balke. The Balke Principle reads:

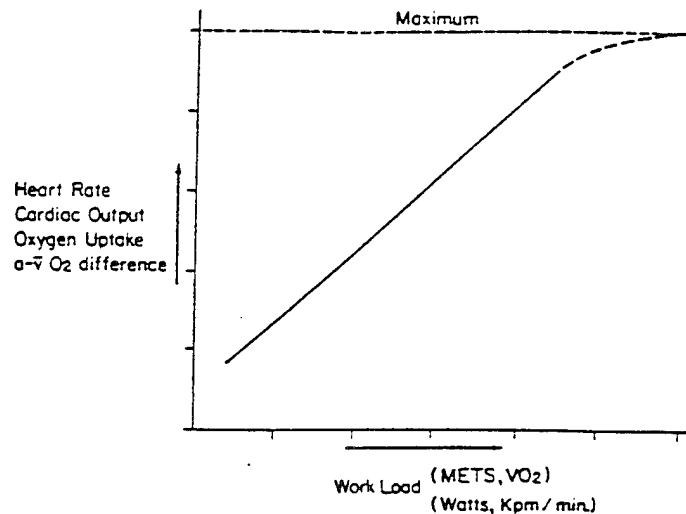
#### THE BALKE PRINCIPLE

Progressive increases in physical workload upon an individual under standard environmental conditions result in predictable physiologic responses\*.

\*Physiologic as opposed to pathologic.

## PHYSIOLOGIC RESPONSE TO PHYSICAL WORKLOAD

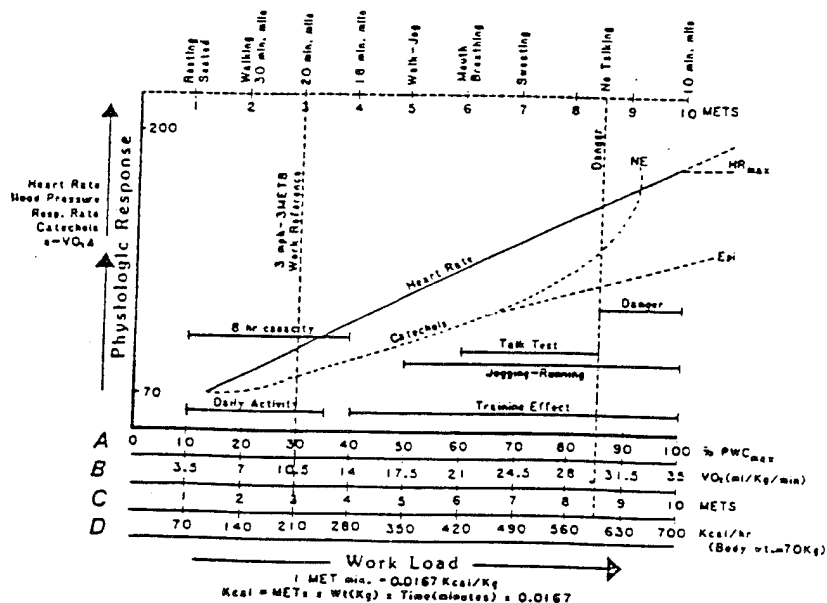
The Balke Principle as developed on the X-Y Plot shows the physiologic parameter/energy expenditure relationship. As workload increases, physiologic parameters respond with predictable increase. Heart rate is especially useful as a monitoring modality.



Developing the X-Y Plot of the Balke Principle into specific physiologic response to physical demands results in a mechanism for interpreting the prospects for physical performance of a prospective wilderness venturer.

Responses can be plotted according to the X-Y Plot as shown below. Prediction of tolerance and planning for venture demands can then be more precise. Physiologic markers, "Body Signals" or pathologic "Symptoms" may be anticipated according to workload.

## PHYSIOLOGIC RESPONSE TO WORK LOAD



## BODY SIGNALS

Physical activity generates signals from various organ systems. These signals help the individual monitor the effect of activity on specific organ systems and on the body as a whole. The brain can then serve as a "gauge" monitoring these signals, and can interpret their meaning. Learning to read these "Body Signals" can result not only in pacing physical activity, but also can add to the success, safety, and perhaps survival during wilderness ventures.

Body Signals are defined as either: 1) Primary, or 2) Secondary. Primary Body Signals are derived from the cardiovascular and respiratory systems. Primary Body Signals are rather easily detected and can be defined by a numerical scale. The most common cardiovascular body signal is heart rate. The most common body signals associated with the respiratory system are respiratory rate and volume.

Secondary Body Signals are included in the outline and often are more subtle. A brief classification of body signals is reflected in the table on the next page.

## BODY SIGNALS

### PRIMARY

#### Cardiovascular-

1. Heart rate
2. Pounding in the head (especially in the temples from the blood pressure)
3. Chest pain, physiologic or pathologic
4. Arrhythmia

#### Respiratory-

5. Mouth-breathing begins at 60% of maximal physical capacity
6. Can't talk above 85% (Talk test)
7. Air hunger
8. Cough
9. Cheyne-Stokes associated with hypoxia and restless sleep
10. Cyanosis

### SECONDARY

#### Musculoskeletal-

11. Tremulousness in legs, knee pain (quadriceps weakness), cramps
12. Shivering
13. Sweating

#### Gastrointestinal-

14. Abdominal distention
15. Flatus associated with altitude
16. Loss of appetite with altitude
17. Dry mouth with altitude

#### Genitourinary-

18. Urinary frequency associated with climbing (The "hochdiurese" of the Alpine climbers)

#### Sensory-

19. Visual changes
20. Tubular vision at altitude
- 21.. Loss of color discrimination
22. Loss of night discrimination (equals hypoxia)
23. Central white spot; Visual spot associated with hypoxia
24. Sense of touch
25. Taste
26. Smell (decreased with hypoxia)

#### Neurologic

27. Headache
28. Lack of analytical decisiveness
29. Confusion or lack of rational behavior



## EXAMPLES OF USING BODY SIGNALS IN WILDERNESS VENTURES

Let's turn to four scenarios of wilderness ventures taken from the monograph Work Physiology in Wilderness Activities:

### Case 1-

. . . the rhythmic step rest cadence carried the lead team of three mountaineers well past the Cleaver at 13,000 feet on Mount Rainier. The puff-breathe rhythm sustained the first team. Breathing through their mouths, they maintained a pace comfortable for all. Lagging behind, the second team of three encouraged the number 2 man on the rope. Pale and shivering, his legs felt like rubber. He seemed confused and complained of visual changes. Should both teams proceed, turn back, or should they split up?

### Case 2-

. . . Six hikers, packs on their backs, joked and laughed as they moved crisply along the trail six hours into their second day. Behind straggled four tired colleagues, quiet and expressionless, and breathing through their mouths. Will they arrive at the lakeside in time to make camp?

### Case 3-

. . . The four man EMT rescue team, their vehicle parked on the hot canyon edge, descended into the sun-baked ravine. Rattlesnakes reserved the only natural rest stops. Each man carried his assigned 60 pound load. The heavy one, shedding his shirt, stopped often to shift his pack, mop his brow, or tie his shoes. His muscles were turning to jelly, except when the cramps in his legs were so bad that he couldn't walk. The others had to

wait for him. In addition to the injured hiker, will the team have to carry out one of their own?

Case 4-

. . .A family of four, the mother, the father, and the 6 year old and 4 year old children, arrived a little later than they had planned at The Great Smoky Mountain National Park. Because they had looked forward to it all week, they ventured up the trail later in the day and went farther than they had intended. On their return, caught by the dark and lacking warm clothing, the children lagged behind, the parents lost direction, and the cold set in. Can they recognize the shivering and confusion associated with hypothermia? And do they have the skills to survive the night?

It must be remembered that these physiologic clues are developed primarily for understanding an individuals response to physical activity in the wilderness setting.

However, physiology never replaces judgement or wisdom. In a review of wilderness venture leaders, an interview was clearly felt to be the best predictor of safe and successful wilderness ventures. This was the origin of the term "SALTY DOG SCIENCE".

Remember the old East Tennessee Mountain expression, "I wish I understood everything I know". Salty Dogs usually "know" pretty well. This physiologic program is to help "understand" responses.

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Friday, August 11, 1995

# SOFT EVAC SYSTEMS

*Bill Clem, MD*

**SOFT EVAC SYSTEMS**  
**Bill Clem, MD, FACEP**  
**National Medical Advisor, Mountain Rescue Association**  
**Golden, Colorado USA**

In the Mountain Rescue community, a world of diversity can be seen in the techniques and equipment used from the Southern Alps of New Zealand to the Alaska Range. Over the past few years, many rope and cable based rescue techniques have become more standard as the trade in techniques ebbs and flows. In one area, that of patient packaging and handling, the techniques remain as unique as the dialects of the rescuers. In Europe, Mariner stretchers are still seen. In Great Britain, Peter Bell litters and MacInnes litters predominate. In the United States, we rely on a contraption dreamed up by a pipefitter and a chicken farmer, just in time for shipboard rescues in World War II, the Stokes litter. All of these litters have in common exceptional weight and bulk.

Litters must provide a number of advantages to both the patient and his rescuers. Protection from side and bottom impact, a certain rigidity to protect fractured body parts and reasonable comfort for the victim should be provided. Protection from the weather and prevention of heat loss must be addressed. The rescuers need a stable platform for both vertical and low angle evacuations; the litter should be easily rigged and carried. Ideally these goals would be met with a litter system that is both strong and very lightweight. Stainless steel Stokes and Peter Bell litters fit most of these requirements with average weights of 50 pounds (23 kg) and 70 pounds (31 kg) respectively. The aluminum MacInnes litter is lighter, although just as bulky. Magnesium-Aluminum alloy Stokes litters can weigh as little as 17 pounds (8 kg) but are susceptible to damage from rough handling. Various attempts have been made to make fiberglass or polyethylene litters lighter but these often suffer from poor handling and poor patient security. And, of course, none of these litters include protection from the weather and patient comfort is of little consideration.

The use of evacuation or casualty bags has been a predominantly European technique and like other litters these have their own advantages and disadvantages. The trade is made to reduce bulk and weight while sacrificing patient protection, rigidity and a good working platform for the rescuers. Newer splinting methods, namely the vacuum mattress, offer a method to improve some of the drawbacks of the casualty bag. By attaching a sleeping bag top to a vacuum mattress we have attempted to provide good patient splinting, excellent patient comfort and adequate protection from the environment, both in cold protection and impact protection. While weight has been dramatically reduced, bulk has remained roughly equivalent to other litter systems. The major disadvantage seems to be in reduced handling capability and the loss of a rigid platform in the vertical environment.

Using some simple tests, weight and bulk (as in volume) were measured comparing the Stokes litter system and this Soft Evac system. Field tests were arranged to gather comments from experienced mountain rescuers and their patients.

Following this presentation, participants will be able to discuss the advantages and disadvantages of various evacuation systems and be able to evaluate other, different systems with regard to needed requirements in mountain rescue operations.

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Friday, August 11, 1995

# INTRODUCTION TO ISTM

*Jay Keystone, MD, FRCPC*

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*Material on the ISTM will be available at the presentation.*

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Friday, August 11, 1995

**TEN COMMANDMENTS  
OF THIRD WORLD  
TRAVEL**

*Jay Keystone, MD, FRCPC*

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## **Ten Commandments for Tropical Travel**

**J. S. Keystone, M.D.**

### **Objectives:**

*At the conclusion of this lecture you will:*

1. have an overview of the important aspects of health advice which should be provided to overseas travellers
2. be able to find and obtain information resources used for providing up-to-date pre-travel health advice
3. be able to protect yourself from a variety of health risks and self-medicate illnesses which might occur during travel
4. wonder why people would want to subject themselves to health risks associated with overseas travel

# TEN COMMANDMENTS FOR TROPICAL TRAVEL

## INTRODUCTION

A famous tropical medicine expert likes to say about staying healthy in the tropics that "You can do everything right and become ill, or do everything wrong and keep well...your state of health depends largely on common sense, good luck and your ability to fight off infectious agents and survive chaotic road traffic." A few extra precautions with respect to food preparation, water purification and protection from insect bites may require a change in your life style but will, in the long run, make tropical living a more pleasant and healthy experience.

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## I THOU SHALT CONSULT WITH THY PHYSICIAN

### A. *Preparation for Travel:*

1. Dental care or other minor ailments.
2. Supply of necessary medications.
3. Letter regarding current disease.
4. Medic Alert Tag.
5. Prophylactic medications and advice.
6. Eye glasses: extra pair, prescription sun glasses.
7. Health Insurance:
  - International S.O.S. Assistance (repatriation)  
Canada: (514) 874-7674  
USA: (215) 244-1500

### 8. Health Information

- I.A.M.A.T.  
Canada: 1287 St. Clair Ave. W.  
Toronto, Ontario M6E 1B8  
Tel: (416) 652-0137  
or  
40 Regal Road, Guelph, Ontario N1K 1B5  
Tel: (519) 836-0102  
Fax: (519) 836-3412



◦ I.A.M.A.T.

U.S.A.: 417 Centre Street  
Lewiston, N.Y. 14092  
Tel: (716) 754-4883

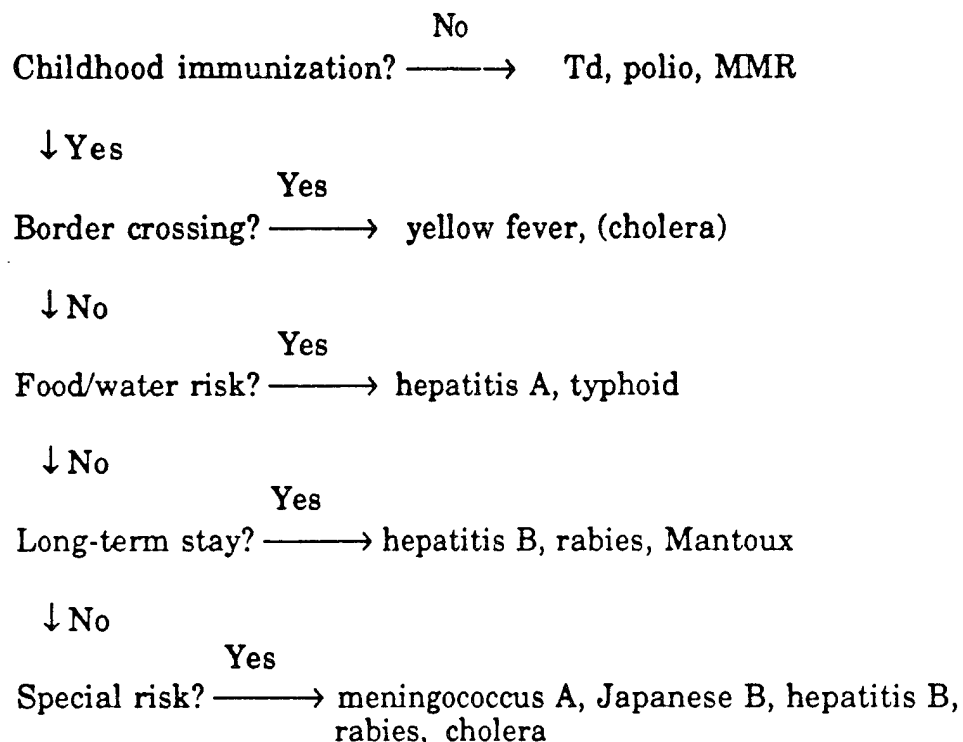
*B. Immunization:*

*i. Travel vaccines:*

Class	Vaccine	Booster (yr)	Indication
a. Routine	tetanus	10	All travellers
	diphtheria	10	All travellers
	polio (oral)	once	All travellers
	polio (inj.)	10	All travellers
	MMR	once	
b. Required (x Inter- national borders)	yellow fever	10	South America and Africa
	cholera	.5	none/exemption
c. Recommended	typhoid (inj)	3	Off tourist routes or prolonged stay.
	typhoid (oral)	7	Off tourist routes or prolonged stay.
	gamma globulin	.3-.5	SubSaharan Africa, East Africa, Nepal, and New Delhi.
	hepatitis A	3-5	Health care profes- sionals and promiscuous persons.
	meningococcus	2-3	Animal contact, children, long stay travellers
	hepatitis B	none	Rural Asia, S.E. Asia >3 wks, temperate: summer, tropical: year round.
	rabies	2	
	Japanese B encephalitis	4	

## ii. Immunizations according to risk:

Vaccinations are administered according to the health risk which the traveller is likely to incur. Short term travellers staying in first class hotels, in urban centres need less protection than those adventurous souls who plan to stray off the usual tourist routes or live for prolonged periods in the developing world.



## iii. New Vaccines:

### 1. Hepatitis A: (Havrix, SKB)

- a. risk:
  - 3-20/1000/mo. travel
  - symptoms  $\propto$  age
  - adults - 30 days missed work
  - relapse rate up to 20%
  - overall mortality ~ 0.2%; 3% > 50 yrs. of age
- b. efficacy:
  - protection ~ 85+ %
  - 95-99% seroconversion at 2 wks (1440 EL.U)
  - duration of protection 3 yrs → 20 yrs.
- c. safety:
  - 60% local reactions at injection site
  - 10% flu-like symptoms

- d. dose:
- Canada: 720 EL.U. 0, 1, 6-12 mo.
  - U.S.: 1440 EL.U. 0, 6-12 mo.
  - Children (U.S.) 2-18 yrs. 360 EL.U.
  - Children(Can) 2-15 yrs. 360 EL.U.

## 2. Typhoid: (Ty 21a, Berna; Typhim vi, Connaught)

- a. risk:
- 3 - 30/100,000/month of travel
  - case fatality ratio 1.3%
- b. efficacy, adverse effects, duration of protection:

### Typhoid vaccine comparison

Parameter	TY21A (Vivotif)	Polysaccharide (Typhim V)
route	oral	IM or sub Q
doses	4	1
admin.	self	supervised
efficacy	70%	70%
immunity	local & systemic	systemic
onset protect.	2 wks	1 wk
duration	7 yr	3 yr
adverse rct.	GI upset	local pain
contra-I	<6 yr of age pregnancy	<2 yr ----
consider	refrigeration cool drink no antibiotics no antimalarials	

## 3. Cholera: (CVD 103 - HgR, Swiss Serum & Vaccine Institute)

- a. risk:
- 1: 500,000 travellers; 2% fatality rate
- b. vaccine:
- live attenuated V. cholerae 01 with A subunit deletion (lyophilized)
- c. efficacy:
- classical: 85%, El tor: 65% protection
  - symptomatic - 94% <1.0L stool
  - 100% protection against mod-severe diarrhea x 6 months

- d. safety: 4% diarrhea
- e. dose: 2 sachets in single oral dose

### C. Medicinals:

- Antimalarial
- Antidiarrheal (loperamide/cipro/nor/ofloxacin)
- Antiemetic (dimenhydrinate)
- Analgesic (codeine)
- Antihistamine (hydroxyzine, terfenadine)
- Antipyrexial (tylenol, ASA)

### AN ANTIBIOTIC FOR ALL REASONS?

	Bowel	Bladder	Resp.	Skin
Ciprofloxacin	+++	+++	+	+
Cotrimoxazole	++	+++	++	++
Cephalexin	---	++	++	+++
Cefuroxime	---	+	+++	+++
Clarithromycin	---	---	+++	+++
Clavulin	---	---	+++	+++

Most medications are available OTC in most developing countries.

## II. THOU SHALT ACCLIMATIZE THYSELF

- Adequate fluids
- Extra-dietary salt
- Adequate rest
- Loose fitting, light coloured, cotton clothing
- Sunscreen - SPF 15 or greater
  - oxybenzone, anthrinilates
- Altitude sickness: acetazolamide, 250 mg twice daily  
dexamethasone, 4 mg thrice daily  
nifedipine SR, 20 mg thrice daily (HAPE)
- Jet lag:
  - a. sleep/wake time shift:
    - westbound: go to bed later and waken later.
    - eastbound: go to bed earlier and waken earlier.

- b. light-exposure alteration:
  - eastbound:  $\geq 6$  time zones:  $\uparrow$  a.m. light
  - 7-12 time zones:  $\uparrow$  p.m. light
  - westbound: reverse of eastbound
- c. Triazolam: prograde amnesia, "rebound".
- d. Melatonin: 2-6 mg @ health food store
  - eastbound: (p.t. dep.) 2-3 a.m. "destination time"
    - $\times 3$  d; (arr.) bedtime  $\times 4$  d.
  - westbound: (arr.) bedtime  $\times 4$  d.

### III. THOU SHALT PROTECT THYSELF FROM INSECTS

"Malaria-carrying mosquitos bite between dusk & dawn."

- Insect repellents:

DEET    30% 4 - 6 hrs protection  
           90% 8 - 10 hrs protection  
           - sparingly on young children

- Permethrin-impregnated bet nets
- Long-sleeves, trousers
- Avoid drying clothes on the ground.
- Screened accommodation

### IV. THOU SHALT NOT WALK IN THY BAREFEET

Proper footwear can protect the traveller from injury (cuts, snake bites), insects (sandfleas, ticks), and parasites (hookworms, strongyloides), which are found in the sand and soil.

### V. THOU SHALT PURIFY THE WATER THAT THOU DRINKEST INCLUDING THY CUBES OF ICE

#### A. Recommendations:

1. Canned or bottled "carbonated" drinks and beverages made from boiled water are safe.
2. Ice should be made from purified water.
3. First-class hotels are no guarantee of adequate water purification.
4. Filtration alone is **not** recommended, but removal of particulate matter will enhance the efficacy of chlorine and iodine.

#### B. Water Purification:

1. Boil water - bring to a boil and then filter for taste and aesthetics.

## NEW INSECT REPELLENTS

REPELLENT	CONTENTS	DURATION OF ACTION	DISPENSED	COMMENT
ULTRATHON (3M)	35% DEET + polymer EPA reg. for children moisture, absorption resistant	12 hour protection	1 oz. cream	mosq., flies, fleas, ticks, etc.
SKEDADDLE (LITTLE POINT)	9.5% DEET + polymer 70% ↓ absorption	> 4 hr. protection	12, 6 ml. applications 3 oz. tube	mosq., flies, fleas, ticks, etc.
DEET PLUS (SAWYER)	17.5% DEET (mosq.) 2.5 R-326 (flies, fleas etc.) MGK-264 enhancer	mosq. 4 hrs; flies 12 hrs.	2 or 4 oz. spray pump bottle 2 oz. lotion	
DURANON TICK REPELLENT (COULSTON)	permethrin	2 wk. protection	6 oz. spray can	repels ticks, chiggers, mos- quitos, spray on outer clothing clothing while off dry 2-4 hrs. (4 if humid)

### C - Portable water filters/purifiers

	PUR (purifier)	WATER TECH (purifier)	TRAVEL WELL (purifier)	KATADYNE (filter)	FIRST NEED (FILTER)	OASIS (purifier)
Weight (kg) Height (cm)	0.35 17.5	0.10 10.4	.63 18	.66 25	0.35 15	0.185 20
Time to clear	240 ml in seconds	180 ml in 3 min.	180 ml in 4 min.	1 litre in 1 min.	0.5 L in 1 min.	0.5L in 1 min.
Quantity treat- ed before re- placement (L)	450	450	450	?	400	675
Mechanism of action	filter + ion exchange resin (trilodide)	ion exchange resin (pentacide)	filter + iodine resin complex	silver impregnated ceramic filter	carbon matrix, silver impregnated filter	filter + ion exchange resin (pentacide)
Cost (Can \$)	\$60	\$35	\$60	\$245	\$69	\$55
Comments:	immediate potable water	long waiting time after passage; compact and light-weight	long waiting time after passage; heavy; limited availability	expensive; large volume filtered; heavy	large volume filtered	immediate potable water

2. Chemical disinfection (per quart for 30 minutes).

	clear (room temp)	cloudy water or <u>cold clear water</u>
2% tincture iodine	5 drops	10 drops

## VI. THOU SHALT COOK WELL THY FOOD

Food spoils rapidly in a tropical climate, especially meat, poultry and dairy products. With the high humidity and temperature of the tropics, foods become an excellent culture media for bacterial growth. Therefore, even light contamination can lead to dangerous bacterial levels within a few hours.

### A. *Food Hygiene:*

#### 1. **Avoid:**

- using leftovers
- blown tins or "swells" with canned food
- unpasteurized milk and milk products
- raw shellfish
- food from street vendors
- letting heated food stand and cool before serving
- cold meats in restaurants

#### 2. **Do:**

- cook all food well (especially meat and seafood)
- wash or soak fruit and vegetables before eating; sodium hypochlorite, chlorox bleach, etc.

## VII. THOU SHALT WASH AND PEEL THINE OWN FRUIT & VEGETABLES

The use of "night soil" (human excrement) for fertilizer, the custom of "fresh-ening-up" vegetables with impure water, and contamination by food handlers make fruit and vegetables a special risk for transmission of infectious agents. Therefore, eat only fruit and vegetables which you peel and wash yourself....cook and bake those which cannot be treated in this way.

### A. *Management of Diarrhea:*

#### 1. **Fluid Replacement:**

- a. discontinue milk products
- b. WHO electrolyte/glucose mixture (e.g. GastrolYTE)
- c. do-it-yourself: (alternate one glass #1 and #2)

- #1. eight ounces of fruit juice (orange juice should be diluted) 1/2 tsp. honey, sugar or corn syrup, pinch of salt.
- #2. 8 oz. water, 1/4 tsp. baking soda.



## 2. Antimotility Agents:

a. diphenoxylate HCL (lomotil)

b. loperamide (Imodium)

Use alone for mild diarrhea or with an antibiotic in case of moderate to severe illness.

Note: Do not use antimotility agents alone in case of severe illness.

## 3. Antibiotics: (\* - quinolones are drugs of choice)

### a. Standard therapy:

ciprofloxacin	500 mg*)
norfloxacin	400 mg*)
ofloxacin	300 mg*) - 2 x daily x 3 d.
cotrimoxazole DS	1 tab )
trimethoprim	200 mg )

### b. Single dose therapy:

cotrimoxazole	4DS )
ciprofloxacin	500 mg - 1 gram*) - ± imodium
norfloxacin	800 mg*) )
floxacin	400 mg*) )

### c. Non-antibiotic:

Bismuth subsalicylate (Pepto Bismol)

i. liquid - 1 oz. every 1/2 hr x 8 doses

ii. tablets - 2 tabs every 1/2 hr x 8 doses

## B. Prevention of Diarrhea: (short-term travel, <3 wks)

### 1. Antibiotics: (\* drugs-of-choice)

Drug	Dose	% Protection
trimethoprim	200 mg/d	52-59
cotrimoxazole	1 tab/d	73-95

### 1. Antibiotics: (\* drugs-of-choice) (Continued)

*ofloxacin	300 mg/d	---
*norfloxacin	400 mg/d	88
*ciprofloxacin	500 mg/d	90
*perfloxacin	400 mg/d	---

Pepto Bismol

a. liquid: 2 oz.	4x/d	63-75
b. tablets: 2 tabs	4x/d	

**2. Travellers for whom antibiotic prophylaxis might be considered:**

- a. Poor "track-record" travellers
- b. V.I.T.'S (Very Important Travellers)
  - athletes
  - military
  - business persons
- c. Low gastric acid
  - antacids or H-2 blockers
  - gastric surgery
- d. Underlying medical problems
  - diabetes mellitus
  - renal insufficiency
  - inflammatory bowel disease
  - immune compromised

## **VIII. THOU SHALT TAKE AND WEAR THY PROPHYLACTICS**

*A. HIV infection and International Travel:*

**1. HIV Screening of International Travellers:**

Many countries in Eastern Europe, the Middle East and Asia now have policies to screen international travellers. For the most part, screening requirements apply only to long-term travellers (e.g. foreign students and workers). It is important to note that some countries will not accept the results of HIV testing in North America and insist on testing for HIV soon after an international traveller arrives. The list of HIV testing requirements for entry into foreign countries changes frequently and therefore up-to-date information should be obtained from the embassy or consulate of the country which you plan to visit.

**2(a) Precautions for avoiding HIV infection:**

Pre-packaged 'AIDS Kits' which contain sterile syringes and needles are available from STERI-AID, Tel: 1-800-56-STERI. Those who plan to carry medical equipment should be aware that such items might be misconstrued by immigration officials to be tools for illegal drug use. A note from a physician which indicates why one is carrying these items might prevent an uncomfortable situation. Also, long-stay travellers should have their blood type determined prior to overseas travel.

## 2(b) Do's and Don'ts re: HIV

### DONOT

- engage in unsafe sex
- pierce ears
- accept acupuncture injections (reused needles)
- receive transfusion
- use illicit injectable drugs

### DO

- use latex condoms
- associate socially
- share food, hug etc.

## 3. The traveller who is HIV positive:

The principal concern for individuals infected with the AIDS virus, HIV-1, is the impact that travel may have on their health.

The issues to be considered include: 1) restrictions for crossing international borders; 2) vaccination effectiveness and safety; 3) susceptibility to infections in the developing world; and 4) accessibility and cost of overseas health care. Live virus vaccines, such as yellow fever, oral polio, mumps and rubella, may not be safe for those with AIDS but may be given to asymptomatic, HIV positive individuals if they are at high risk of exposure.

## B. Malaria Chemoprophylaxis:

### Principles:

- Most antimalarials do not actually prevent infection but suppress clinical symptoms.
- Start antimalarials 1-2 weeks before exposure, continue while away and for 4 weeks after departure from a malarious area.
- No antimalarial drug regimen guarantees protection against malaria; therefore, insect precautions must be used.
- Fever in a returning traveller, especially within the first two months after return, is a medical emergency and requires thick and thin films to rule out malaria.

## Malaria Chemoprophylaxis According to Geographic Area

Regimen	Drug of Choice	Alternative Drug
<b>Chloroquine sensitive</b>		
Central America Caribbean Middle East (part)	chloroquine	proguanil mefloquine
<b>Chloroquine resistant</b>		
1. S. America Amazon (Brazil)	mefloquine mefloquine	chloroquine+ pyrimethamine sulfadoxine <sup>a</sup> doxycycline <sup>b</sup>
2. Asia	mefloquine or	chloroquine +pyr/sulfadoxine <sup>a</sup>
3. Africa (subSaharan)	mefloquine	chloroquine + proguanil + pyr/sulfadoxine <sup>a</sup>
4. S.E. Asia and Oceania	mefloquine <sup>b</sup>	doxycycline
<p><b>a</b> (Fansidar) Single-dose presumptive therapy when prompt medical attention is not available.</p> <p><b>b</b> Doxycycline is recommended for those staying overnight along the Thai-Cambodian or Thai-Myanmar (Burma) borders.</p>		

## Treatment of Malaria (by oral route)

### A. Chloroquine Sensitive malaria: (*P. vivax*, *P. ovale*, *P. malariae* and sensitive strains of *P. falciparum*)

	Adult Dose	Pediatric Dose
Chloroquine phosphate (Aralen) (250 mg. salt = 150 mg base per tablet)	1 gram of salt (4 tabs) immediately; then 500 mg (2 tabs) in 6 hrs, then 500 mg (2 tabs) daily for 2 days	10 mg base/kg (max. 600 mg) immediately; then 5 mg/kg in 6 hrs, then 5 mg/kg/day for 2 days.

### B. *P. vivax* and *P. ovale* malaria:

To prevent relapses; after chloroquine therapy add:

Primaquine (21.5 mg salt = 15 mg base/tablet)	15 mg base (1 tab) daily for 14 days	0.3 mg/kg/day for 14 days
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### C. Chloroquine-resistant malaria

Quinine sulphate	600 gm salt q8h* x 3-7 days (7 days required in S.E. Asia).	10 mg salt/kg q8h x 3-7 days (7 days required in S.E. Asia).
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Plus one of the following:

1. Fansidar	3 tablets (75 mg pyrimethamine and 1500 mg sulfadoxine) once.	1.25 mg/kg of pyrimethamine and 25 mg/kg of sulfadoxine once.
2. Tetracycline Doxycycline or	250 mg q6h x 7 days 100 mg q12h x 7 days	Contraindicated under 8 years of age.
3. Clindamycin	10 mg/kg q8h x 5 days	Same as adult dose.

#### Alternatives:

Mefloquine alone	1-1.5 gms (base) as a single dose. (4-6 tablets)	Inadequate studies
Fansimef alone	750 mg mefloquine plus 75 mg of pyrimethamine plus 1500 mg of sulfadoxine (3 tablets)	10 mg/kg of mefloquine base plus 1 mg/kg of pyrimethamine plus 20 mg/kg of sulfadoxine.
Halofantrine alone	500 mg q6h x 3 doses (repeat in 1 week)	8 mg/kg q6h x 3 doses repeat in 1 week

\*q8h = every 8 hours.

## Antimalarial Drugs for Prophylaxis

Generic Name	Trade Name	Tablet Size	Adult Dose	Pediatric Dose	Adverse Effects
1. chloroquine phosphate	Aralen	250 mg (150 mg base)	500 mg (300 mg base) once weekly	< 1 yr - 37.5 mg base 1-3 yr - 75 mg base 4-6 yr - 100 mg base 7-10 yr - 150 mg base 11-16 yr - 225 mg base once weekly	Freq: Pruritus, vomiting, headache Occas: Hair depigmentation, skin eruptions, retinopathy (>100 g base) myopathy Reversible corneal opacity, partial alopecia, blood dyscrasias Rare: nail & mucous membrane discoloration, nerve deafness, photophobia
chloroquine sulphate hydroxy-chloroquine	Nivaquine Plaquenil	200 mg (150 mg base)	400 mg (310 mg base) once weekly		
2. chloroquine (proguanil)	Paludrine	100 mg	100 mg once daily 200 mg in chloroquine resistant areas	< 2 yr - 25 mg 3-6 yr - 50-75 mg 7-10 yr - 100 mg once daily (double dose in chloroquine resistant areas)	Freq: mouth ulcers Occas: anorexia, vomiting, diarrhea Rare: hematuria
3. doxycycline	Vibramycin	100 mg	one tablet once daily	< 8 yr - 2 mg/kg once daily (max. 100 mg daily)	Freq: G.I. upset, staining of teeth in children and fetuses Occas: photosensitivity, azotemia in renal disease, enterocolitis Rare: allergic reactions, blood dyscrasias
4. Mefloquine	Lariam	250 mg	250 mg once weekly	15-19 kg: 1/4 tab. 20-30 kg: 1/2 tab 31-45 kg: 3/4 tab	Common: dizziness, nausea, vomiting, diarrhea, hives, sinus bradycardia, nightmares, insomnia, mood alteration Occas: hair loss, skin rash Rare: seizures, psychosis
5. pyrimethamine dapsone	Daraprim	25 mg	25-50 mg once weekly	< 2 yr - 6.25 mg 3-10 yr - 12.5 mg < 10 yr - 25 mg once weekly	Occas: folic acid deficiency Rare: rash, vomiting, shock, convulsions, blood dyscrasias
6. pyrimethamine dapsone	Maloprim	12.5 mg 100 mg	one tablet weekly	< 2 yrs - 1/4 tab 3-10 yrs - 1/2 tab > 10 yrs - 1 tab once weekly	Freq: hemolysis in G6PD deficiency Occas: folate deficiency Rare: blood dyscrasias rash, vomiting
7. Self-treatment a. pyrimethamine sulfadoxine	Fansidar	25 mg 500 mg	3 tabs. (75 mg pyrimethamine & 1500 mg sulfadoxine) in a single dose	2-11 mos - 1/2 tab 1-3 yr - 1/2 tab. 4-8 yr - 1 tab 9-14 yr - 2 tabs > 14 yr - 3 tabs as a single dose	Occas: headache, nausea, vomiting, folate def Rare: Stevens-Johnson syndrome, erythema multiforme, toxic epidermal necrolysis
b. halofantrine	Halfan	250 mg	2 tabs q6h x 3 doses (repeat in one week)	8 mg/kg q6h x 3 doses (repeat in one week)	Occas: pruritus, cough, GI upset, cardiac conduction abnormality (1 Q-T)

## IX THOU SHALT SWIM NOT IN FRESH WATER

1. Do not swim, wade or walk in slow moving, fresh water lakes, rivers or streams in areas where schistosomiasis is known to occur.
2. If fresh water contact is unavoidable, dry off quickly to prevent the parasite from penetrating the skin.
3. If you must swim in a lake, use the deepest portion at the centre and avoid the edges at which snails are likely to breed.
4. Infested water which is allowed to stand (eg. in a barrel) for 48 hours, or which is chlorinated, loses its infectivity and may be safely used for bathing.

## X THOU SHALT BE WARY OF THY CONVEYANCE

Motor vehicle accidents are the leading cause of accidental deaths of long-term travellers living in the third world. A significant portion of those deaths can be attributed to accidents involving motorcycles. In countries where "rules of the road" are not enforced or are non-existent and where blood transfusions and injections may carry potentially deadly viruses (HIV, Hepatitis B), there are several common-sense recommendations which should be followed:

- avoid over-crowded public vehicles
- avoid rural travel by road after dark
- avoid riding on motorcycles

### Further Reading:

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J.S. Keystone, M.D.  
June, 1995



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Friday, August 11, 1995

# PROTECTION AGAINST INSECTS

*Elaine Jong, MD*

## PROTECTION AGAINST INSECTS

Elaine C. Jong, MD  
Clinical Professor of Medicine  
Co-Director, Travel & Tropical Medicine Service  
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### I. INSECTS

- A. Ubiquitous
- B. Bites
  - 1. Local trauma, pain, swelling, itching
  - 2. Local hypersensitivity reaction
  - 3. Systemic hypersensitivity reaction
  - 4. Cause breaks in the skin barrier, creating a "portal of entry" for various infections
  - 5. Serve as vectors for viral, rickettsial, bacterial, and parasitic diseases

### II. PROTECTION AGAINST INSECTS

- A. Environmental
  - 1. Destroy nearby insect breeding sites  
Examples:
    - a. Drain swamps
    - b. Eliminate standing water in old tires and cans
    - c. Repair old buildings
  - 2. Spray insecticides in high risk areas outdoors and indoor living areas
  - 3. Burn insect coils or use plug-in vapor mats in closed indoor spaces
- B. Limit exposure outdoors
- C. Barriers
  - 1. Screens on windows and doors, or air-conditioned rooms
  - 2. Bednets
  - 3. Protective Clothing-- long sleeves, long pants, loose-fitting
- D. Avoid insect attractants
  - 1. Avoid perfumes, cologne, aftershave, etc.
  - 2. Avoid dark clothes
- E. Personal use of insect repellents and insecticides
  - 1. Skin application
  - 2. Spray on or use to impregnate external clothing, wrist & ankle bands
  - 3. Spray on or use to impregnate bednets, tent-flaps, curtains

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## INSECT REPELLENTS AND INSECTICIDES\*

### INSECT REPELLENTS CONTAINING DEET: FOR SKIN APPLICATION

*DEET = N,N-diethyl-m-toluamide effective against mosquitoes, ticks, sand-flies, fleas, blackflies (not against stinging insects)*

*Product examples*

**ULTRATHON Insect Repellent:** 35% DEET in polymer formulation, cream, up to 12 hr protection against mosquitoes; also effective against ticks, biting flies, chiggers, fleas, gnats (3M, Minneapolis, MN 55144)

**OFF Skintastic:** 4.75% DEET, non aerosol pump-spray liquid, unscented, gives up to 2 hr protection on treated skin and clothing. (S.C. Johnson & Son Inc., Racine, WI 53403-2236)

**REPEL** brand insect repellent available as 7, 15, 18, 20, and 27% DEET. Aerosol, non aerosol pump-spray liquid, and lotion; scented (Family Formula) or unscented (Sportsmen Formula). (Wisconsin Pharmacal Company, Inc., 1 Repel Road, P.O. Box 198, Jackson, WI 53037)

**SKEDADDLE Insect Protection for Children:** 10% DEET using molecular entrapment technology (Little Point Corp., Cambridge, MA)

**DEET PLUS Insect Repellent:** 17.5% DEET with combined with 5% N-octyl-bicycloheptene dicarboximide (insecticide synergist, MGK- 264), and 2.5% Di-n-propyl isoconchomeronate (MGK repellent 326, particularly effective against biting flies). Lotion. Apply every 4 hours for mosquitoes, every 8 hours for biting flies (Sawyer Products, Safety Harbor, FL 34695)

**BODY GARD Insect Repellent:** 17.5% DEET with combined with 5% N-octyl-bicycloheptene dicarboximide (insecticide synergist, MGK- 264), and 2.5% Di-n-propyl isoconchomeronate (MGK repellent 326, particularly effective against biting flies). Lotion. (Sawyer Products, Safety Harbor, FL 34695)

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### "DEET-LESS" INSECT REPELLENTS

**RUTGERS 612:** 2-ethyl-1,3-hexanediol; effective against mosquitoes and chiggers

**NATRAPEL:** citronella is an oil extract (citronellal, a monoterpene aldehyde) from lemon-scented Eurasian grass *Cymbopogon nardus*; provides short term protection (about 1-2 hours) against mosquitoes, sand flies, and black flies (Tender Corporation, Littleton, NH 03561)

**MOSI-GUARD NATURAL:** lemon eucalyptus oil extract from plant *Eucalyptus maculata citriodon*. Provides protection against mosquitoes, midges, ticks, black flies, sandflies, stable flies, and leeches. (MASTA, United Kingdom; "Quwenling" in China)

**SKIN-SO-SOFT:** Commercial bath oil (Avon). Contains: di-isopropyl adipate, mineral oil, isopropyl palmitate dioctyl sodium sulfosuccinate, sunscreen benzophenone. Effective against *Aedes aegypti* for 10-30 min. (Ref: Rutledge, LC. Mosquito news, 1982, vol.42, p.557)

**VITAMIN B 1 (Thiamine):** Anecdotal evidence. No significant benefit in limited field trials.

#### PERMETHRIN-CONTAINING INSECTICIDES-- FOR APPLICATION TO EXTERNAL CLOTHING AND BED NETS

*Pyrethroid compounds include permethrin, deltamethrin, allethrin, lambda-cyhalothrin, alphamethrin.*

##### *Product examples*

**PERMANONE Tick Repellent:** contains permethrin in a pressurized spray can, repels ticks, chiggers, mosquitoes, and other bugs. (Coulston International Corp., Easton, PA 18044)

**DURANON Tick Repellent:** contains permethrin in a formula lasting up to 2 weeks, supplied in a pressurized spray can. (Coulston International Corp., Easton, PA 18044)

**PERMAKILL 4 Week Tick Killer:** 13.3% permethrin liquid concentrate supplied in 8 oz bottle, can be diluted (1/3 oz. permethrin concentrate in 16 oz. water) to be used with a manual pump spray bottle; or diluted 2 oz. in 1 1/2 cups of water to be used to impregnate outer clothing, bednets, and curtains. (Coulston International Corp., Easton, PA 18044)

\*Brand names are given for identification purposes only, and do not constitute an endorsement.

#### STUDIES COMPARING DEET ON SKIN (S) + PERMETHRIN ON CLOTHING (C)

SC= DEET ON SKIN = PERMETHRIN ON CLOTHING

SO= DEET ON SKIN

OC= PERMETHRIN ON CLOTHING

OO= NO TREATMENT

##### MOSQUITO BITES PER HOUR

COMBO	SKIN	CLOTHES	OVERALL	% PROTECTION
SC	1.1	0.0	1.1	99.9
SO	3.5	0.1	3.6	99.7
OC	77.8	0.0	77.8	93.4
OO	1187.3	0.4	1187.7	0

Lillie TH, Schreck CE, Rahe AJ. Effectiveness of personal protection against mosquitoes in Alaska. J Med Entomol 1988 25:475-478.

## TSETSE FLY BITES PER HOUR

COMBO	SKIN	CLOTHES	OVERALL	% PROTECTION
SC	1.4	0.0	1.8	90.7
SO	2.8	0.1	3.8	80.3
OC	11.5	1.2	12.7	34.2
OO	16.3	3.	19.3	0

Scoldt LL, Schreck CE, Mwanggelisa MI et al. Evaluation of permethrin-impregnated clothing and three topical repellent formulations of deet against tsetse flies in Zambia. Med Vet Entomol 1989 3:158.

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SUMMARY OF CLINICAL TRIALS

35% LA (long-acting) deet formulation cream on skin:

>99% protection over 8 hr  
4 bites per person per hr

Permethrin-treated uniform (0.125 mg/cm<sup>2</sup>):

93% protection  
78 bites/hr, compared to  
1,188 bites/hr with no protection

DEET on skin + PERMETHRIN on clothing= 99.9% protection (one bite/hr)

## GENERAL REFERENCES FOR INSECT REPELLENTS

Consumer Reports, July 1987, p. 423  
Medical Letter, 1989, vol.31, p.45-47

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SPECIFIC VECTORS AND DISEASES

- A. Anopheles mosquito- evening & night, indoors & outdoors
  - 1. Malaria (blood protozoan): worldwide tropical & subtropical areas
  - 2. Filariasis (tissue and blood nematodes): Africa, Asia, South Pacific
- B. Culex mosquito- evening & night, indoors & outdoors
  - 1. Filariasis (tissue and blood nematodes): Africa, Asia, South Pacific
  - 2. Japanese encephalitis (virus): Asia, Southeast Asia
- C. Aedes mosquito- day (especially morning & twilight), indoors & outdoors, rural and urban
  - 1. Yellow fever (virus): equatorial Africa and South America
  - 2. Dengue fever (virus): tropical and subtropical areas of Africa, Asia, Southeast Asia, South Pacific, Caribbean, Mexico, Central and South America
  - 3. Filariasis (tissue and blood nematodes): Africa, Asia, South Pacific
- D. Mansonia mosquito- night, outdoors, rural
  - Filariasis (tissue and blood nematodes): Africa, Asia, South Pacific
- E. Chysops fly- day, outdoors, rural
  - Loiasis (*Loa loa*, tissue nematode): West and central Africa

- F. Blackflies (*Simulium*)- day, outdoors, rural  
Onchocerciasis (*Onchocerca volvulus*, tissue nematode): Africa, Arabian Peninsula, Latin America (southern Mexico, Guatemala, Venezuela, Colombia, Ecuador, NW Brazil)
- G. Sandflies- dusk to dawn, indoors & outdoors, rural & urban
  - 1. Sandfly (*phlebotomus*) fever (virus): Africa
  - 2. Leishmaniasis (tissue protozoan parasite): Africa, Asia, Central and South America
- H. Tsetse Flies (*Glossina*)- day, outdoors, rural  
African trypanosomiasis (African Sleeping Sickness) (*Trypanosoma cruzi*, protozoan): Africa
- I. Botfly (*Dermatobia hominis*)- day, outdoors, rural  
Furuncular myiasis: Central and South America
- J. Tumbu fly (*Cordylobia anthropophaga*)- day, outdoors, rural  
Furuncular myiasis: Africa
- K. Ticks- day or night, outdoors, rural
  - 1. Babesiosis (*Babesia* sp., protozoa): North America, Europe
  - 2. Lyme disease (*Borrelia bergdorferi*, spirochete bacteria): North America, Europe, Scandinavia, Australia, former Soviet Union, China, Japan
  - 3. Endemic relapsing fever (*Borrelia* species, spirochete bacteria): worldwide
  - 4. Rocky Mountain Spotted Fever (*Rickettsia rickettsii*): United States, Mexico, Central & South America
  - 5. African tick typhus (Boutonneuse Fever) (*Rickettsia conorii*): Africa, Mediterranean
  - 6. Tickborne encephalitis (virus): Western and Eastern Europe, Commonwealth of Independent States
  - 7. Crimean-Congo hemorrhagic fever (virus): Africa
- L. Fleas- night or day, indoors
  - 1. Plague (*Yersinia pestis*, bacteria): United States, Brazil, Ecuador, Peru, Bolivia, Libya, Kenya, Tanzania, Madagascar, Zimbabwe, South Africa, Angola, Zaire, Uganda, India, Burma, China, Vietnam
  - 2. Murine typhus (*Rickettsia typhi*): worldwide
- M. Lice-night or day, indoors or outdoors
  - 1. Epidemic typhus (*Rickettsia prowazekii*)
  - 2. Epidemic relapsing fever (*Borrelia recurrentis*, spirochete bacteria): highlands of Central and East Africa, South American Andes
- N. Mites-day or night
  - 1. Scrub typhus (*Rickettsia tsutsugamushi*): eastern Asia, South Pacific
  - 2. Scabies (*Sarcoptes scabiei* var. *hominis*, human itch mite): worldwide
- O. Reduviid (Triatome) bugs- night, indoors  
American Trypanosomiasis (Chagas' Disease) (protozoa)

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Friday, August 11, 1995

**WORLD STATUS OF  
MALARIA PROPHYLAXIS**

*Hans O. Lobel, MD*

## PREVENTION OF MALARIA

Hans O. Lobel, MD  
Centers for Disease Control and Prevention

### Educational Objectives

Outline guidelines for prevention of infection

- I. Life cycle of malaria parasites
- II. Drugs used for prevention of malaria
- III. Guidelines for prevention of malaria

Risk of malaria

Malaria prevention

- anti-mosquito measures
- chemoprophylaxis

Drug resistance

Chemoprophylaxis strategies

- Short-term travelers
- Long-term travelers, expatriates
- Women, children

Presumptive therapy

- Advantages and disadvantages
- Fansidar
- Halofantrine
- Mefloquine

How to advise the traveler



References:

Health Information for International Travel. Atlanta, Centers for Disease Control, 1994  
(Publication No. (CDC) 94-8280).

International Travel and Health. Geneva, World Health Organization, 1995.

Lobel HO, et al. Long-term malaria prophylaxis with weekly mefloquine. *Lancet* 1993;341:848-51.

Wyler DJ. Malaria chemoprophylaxis for the traveler. *NEJM* 1993;329:31-7.

**TABLE 11a. Drugs Used in The Prophylaxis of Malaria**

<b>Drug</b>	<b>Adult dose</b>	<b>Pediatric dose</b>
Mefloquine (Lariam <sup>®</sup> )	228 mg base (250 mg salt) orally, once/week	15-19 kg: 1/4 tab/wk 20-30 kg: 1/2 tab/wk 31-45 kg: 3/4 tab/wk >45 kg: 1 tab/wk
Doxycycline	100 mg orally, once/day	>8 years of age: 2 mg/kg of body weight orally/day up to adult dose of 100 mg/day
Chloroquine phosphate (Aralen <sup>®</sup> )	300 mg base (500 mg salt) orally, once/week	5 mg/kg base (8.3 mg/kg salt) orally, once/week, up to maximum adult dose of 300 mg base
Hydroxychloroquine sulfate (Plaquenil <sup>®</sup> )	310 mg base (400 mg salt) orally, once/week	5 mg/kg base (6.5 mg/kg salt) orally, once/week, up to maximum adult dose
Proguanil	200 mg orally, once/day in combination with weekly chloroquine	<2 years: 50 mg/day 2-6 years: 100 mg/day 7-10 years: 150 mg/day >10 years: 200 mg/day
Primaquine	15 mg base (26.3 mg salt) orally, once/day for 14 days	0.3 mg/kg base (0.5 mg/kg salt) orally once/day for 14 days

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Friday, August 11, 1995

# ARCTIC SURVIVAL

*Brian Horner*

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*Please refer to material on Arctic Survival for Thursday, August 10.*

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Friday, August 11, 1995

**ORGANIZATIONAL  
COOPERATION IN  
WILDERNESS MEDICINE:  
TOWARD TRUE CONGRESS**

*Blair D. Erb, MD*

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WORKSHOP #36

ORGANIZATIONAL COOPERATION IN WILDERNESS MEDICINE: TOWARD TRUE CONGRESS

Blair Dillard Erb, M.D., FACP

4:45 - 6:15 p.m. / Friday, August 11, 1995

**OBJECTIVE:** To provide an open forum for discussion of Wilderness Medicine in its many parameters and to improve cooperation among existing organizations with specific reference to:

- 1) Education - To consider the potential for sharing educational interests.
- 2) Research - To review mechanisms for common or parallel research activities.
- 3) Service - To examine prospects for communication among medical and emergency services.
- 4) Information Exchange - To explore mechanisms for communication by written word, by computer, video, etc.
- 5) Administration - To consider resource sharing for common administrative needs.
- 6) Funding - To look realistically at funds potentially available for these activities.

Wilderness Medicine includes a variety of disciplines pulled together by a common commitment to the health, well being and medical care of individuals who participate in activities in the wilderness. When these clinical disciplines are applied to specific settings, we recognize the emergence of categories of Wilderness Medicine; Mountain Medicine, Desert Medicine, Jungle Medicine, Marine Medicine, Travel Medicine, and even Aerospace Medicine. A wide array of services and subjects make up the extensive content of Wilderness Medicine.

For each of these disciplines, categories, services, and subjects, there are one or more organizations involved in their internal exchange of information, ideas and projects. Often, simultaneous similar activities are underway in one or more groups without the knowledge of others who could help in some way.

With the primary purpose of sharing, expanding and refining the field of Wilderness Medicine, both nationally and internationally, this workshop will provide an open forum to discuss Wilderness Medicine in its many parameters and to make specific recommendations for cooperation and communication among organizations. Recognizing that wilderness knows no national boundaries, organizations from interested countries are invited to participate.

President Warren D. Bowman, President-Elect Bruce A. Paton, and Past President Blair D. Erb, as Chairman, will introduce guests and representatives of several organizations as a means of beginning these open discussions.

This workshop is a sequel to the series of the First World Congress in which "The World Status of Wilderness Medicine" was examined. It is our hope that this workshop will lead to true cooperation among the many organizations involved in the extensive facets of Wilderness Medicine.

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Friday, August 11, 1995

# ARRANGING MEDICAL REPATRIATION

*William Casey*

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## **Arranging Medical Repatriation**

William D. Casey  
Phoenix Alliance, Inc.  
Chairman, President & CEO  
St. Paul, Minnesota

**Following this presentation, participants will be able to; conduct, actively participate, or have a resource available to implement medical repatriation.**

**The following are key issues that will be addressed:**

- 1. Understand major issues to be managed in medical repatriation**
- 2. The detailed information necessary to make arrangements for repatriation**
- 3. Identify the stakeholders and involvement in the evacuation**
- 4. Identify the interpersonal skills necessary to efficiently implement repatriation**
- 5. Discuss use of intermediate medical facilities**
- 6. Identify situations which require services of air ambulance**
- 7. Evaluate commercial - vs - dedicated carrier use**
- 8. Identify key factors in selecting an air ambulance carrier**
- 9. Identify areas to consider as part of pre-planning for medical repatriation**



## **1. Understand major issues to be managed in medical repatriation**

Primarily two issues:

- complete communications across different time zones and languages, with people who have rarely been confronted by the need for evacuation; and,
- coordination of services and schedules

Four major stakeholders need to participate in the communication and coordination along with the patient:

- Insurer or those financing the care and transportation
- Transportation providers
- Medical experts - with the patient, air transportation specialists and those who will receive the patient
- Family

## **2. The detailed information necessary to make arrangements for repatriation**

1. Clear understanding of patient needs - short and long term
2. Detail the objective to achieve through the evacuation
3. Time constraints
4. Equipment requirements given patient needs
5. Provide specifics to the stakeholders so that financial arrangements can be confirmed.

### **3. Identify the stakeholders and involvement in the evacuation**

Clearly communicate the objective of the evacuation to all stakeholders and support systems.

- Patient
- Local medical experts
- Family
- Insurer/financing agent
- Air carrier
- Receiving medical facility
- Coordination role - who is it?

### **4. Identify the interpersonal skills necessary to efficiently implement repatriation**

- diplomacy
- sales - "making the mission clear"

### **5. Discuss use of intermediate medical facilities**

As an alternative to transporting a patient to their home location, use of quality medical facilities in an intermediate location can be cost effective and provide excellent patient care. On occasions, this may be required by the insurer/payor.

### **6. Identify situations which require services of air ambulance**

Dedicated medical air ambulance use is warranted based on two factors:

- patient's care during transportation needs to replicate the skilled/hospital level services being delivered
- hassle and expense factors given other alternative care and transportation solutions

## **7. Evaluate commercial - vs - dedicated carrier use**

Commercial carriers can often duplicate the services of a dedicated carrier. Assuming that patient need does not clearly dictate the use of a dedicated carrier, commercial lines should be evaluated.

Key contact to make arrangements is the carrier's medical director or advisor. During scheduled stops and lay-overs, additional care services can be arranged.

## **8. Identify key factors in selecting an air ambulance carrier**

Do not assume that the geographic location of a carrier is the major selection factor. Many carriers have global experience and, regardless of their home base, can successfully complete missions anywhere.

## **9. Identify areas to consider as part of pre-planning for medical repatriation**

Best tactic is to always assume a repatriation will need to occur.

Create a written plan with list of resources to contact. Keep the plan with travel papers/passport.

- knowledge of insurance coverage available and contacts
- identified local physician, hospital, transportation resources
- understand what services can and cannot be delivered by local resources
- potential air carriers/transportation solutions
- how to access and forward medical records
- knowledge of local culture and customs
- family contacts

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Friday, August 11, 1995

**HIMALAYAN RESCUE  
ASSOCIATION**

*Ken Zafren, MD*

## **HIMALAYAN RESCUE ASSOCIATION**

Ken Zafren, MD  
Associate Medical Director (USA)  
Anchorage, Alaska USA

### **OBJECTIVES**

Following this presentation participants will be able to:

1. determine their suitability to work as volunteers at the aid posts run by the Himalayan Rescue Association (HRA) in Nepal.
2. apply for volunteer positions with the HRA or refer others to these positions.
3. identify the main points of preventive medicine as practiced in a remote setting such as trekking areas of Nepal.

## **Himalayan Rescue Association (Nepal)**

by Ken Zafren, MD - Associate Medical Director (USA)

**Introduction:** The Himalayan Rescue Association was founded in the early 1970s and operates an office in Kathmandu as well as two aid posts in the mountains of Nepal. These aid posts use volunteer physicians to serve the medical needs of trekkers and local people. They operate during the two trekking "seasons:" Spring or pre-monsoon and Fall or post-monsoon. Living conditions at both posts are primitive, food is basic and there is little communication with "home." There are two volunteer physicians at each post each season. Volunteers should be willing to put up with the inevitable hassles of living and working in a third-world country as well as with prolonged living under conditions which at home would be associated with wilderness travel.

**Qualifications:** Volunteers must be physicians, usually from the primary care specialties. Emergency physicians and family practitioners are the norm, but others may be considered if they have enough experience beyond their own fields. Mountaineering and mountain rescue skills are not required. Camping skills and a sense of humor are essential.

**Pheriche:** Located in the Khumbu (Everest) region of Nepal, the post usually takes two weeks for volunteers to reach, most of which is spent walking in. The post is located at 14,000 feet and serves the large number of trekkers going to Kala Patar, the most popular spot for close-up views of Mt. Everest. It is cold most of the year, often windy, and the building can only occasionally be heated using scarce firewood.

**Manang:** Located at 11,500 feet on the Annapurna circuit, the most popular trek in Nepal, the aid post sees more local people than Pheriche. Manang is warmer than Pheriche and takes only about a week to reach, of which all but the first day is spent walking.

**General information:** Volunteers pay their own way to and from Nepal. The aid posts operate from 1 March to 7 May (pre-monsoon) and 1 October to 7 December (post-monsoon). Volunteers arrive in Kathmandu by 15 February or 15 September for these seasons and should expect to stay in Nepal for at least 3 months. Prior to leaving for the posts, volunteers help with organizing supplies for the coming season. The Kathmandu office will help with arrangements. Volunteers are fully supported financially only after leaving Kathmandu; however Kathmandu is not a very expensive place. The first few days are devoted to orientation, both medical and a general introduction to working at the posts, as well as sightseeing in Kathmandu. Each volunteer may bring a spouse or significant other who will also be supported. There are no provisions for children at either post.

**The work:** Volunteers are the only source of medical care in each area. In addition to clinic hours (easy to set, but hard to enforce) and emergencies (anytime, just as at home), volunteers give daily lectures emphasizing prevention, recognition and treatment of altitude illness and other medical problems of trekking. The posts support themselves on fees charged for medical services and supplies, donations and the sale of HRA logo items (patches and t-shirts). Medical skills are often less important qualifications than the ability to function in stressful situations and a talent for diplomacy. At each post, local people serve as medical assistants and translators and do most of the cooking and general maintenance.

**The rewards:** Spending a season at one of the posts is an unparalleled opportunity to practice wilderness medicine and to meet people from different cultures, both those of Nepal and of many other countries. Although the scenery is spectacular, it is the local people, especially your assistants living with you at the posts, who make the experience one you will always remember.

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Friday, August 11, 1995

# SKIN DISEASES

*Jay Keystone, MD, FRCPC*

## **Tropical Dermatology**

**J. S. Keystone, M.D.**

### **Objectives:**

*At the conclusion of this workshop you will be able to:*

1. recognize common dermatological conditions seen in returning travellers and immigrants
2. formulate an appropriate differential diagnosis
3. diagnose and manage selected tropical skin diseases
4. understand why dermatologists make so much money



## TROPICAL DERMATOLOGY

### A. APPROACH:

- i. Epidemiology: (appendix 1)
  - geography (itinerary)
  - duration (long, short)
  - location (urban, rural)
  - exposure (trauma, fresh water, barefoot walking, animal contact, insects, sexual activity etc.)
- ii. Pathology:
  - onset relative to travel (early, late)
  - description (appendix 2)
  - pattern (linear, clusters)
  - anatomical location (exposed, unexposed surface)
  - progression (wax/wane, new lesions)
  - associated symptoms (pruritus, pain)
- iii. Most frequently encountered skin problems in travellers:
  - insect bites (2° infected)
  - pyodermas
  - cutaneous larva migrans
  - non-specific dermatitis
  - chronic dermatoses (eczema, psoriasis)
  - photodermatitis

### B. SPECIFIC CONDITIONS:

#### I. MACULOPAPULAR

- i. Insect bites:
  - pattern (clusters, linear)
  - fleas, bedbugs, reduviid bugs
  - painful - tse tse, black fly, ants
  - pruritic - recurrent - papular urticaria
  - Rx: topical steroids, hydroxyzine

- ii. Onchocercal dermatitis: (*Onchocerca volvulus*)
- West, Central Africa, Central and South America
  - very pruritic, trunk and lower extremities
  - immigrants, long-stay travellers (>3 mo.)
  - adults in sub Q nodules; mf in skin & sclera;  
dermatitis -- lichenification -- depigmentation -- presbydermia
  - Dx: skin snips, mazzotti test, skin Bx, serology (N.I.H.)
  - Rx: ivermectin, suramin, diethylcarbamazine

## II. SUBCUTANEOUS NODULES

- i. Tungiasis (chigoe, jigger, sand flea)
- Africa, South and Central America, India
  - female flea burrows into foot
  - painful nodule
  - surgical: extract flea
- ii. Myiasis (Tumbu & Bot fly)
- egg deposition onto skin
  - furunculoid lesion; central opening; usually painful;  
"movement inside" ugh!
  - Rx
    - "suffocate" with paraffin (vaseline, kerosene, bacon fat)
    - extraction by lateral pressure, rarely surgery
- iii. Loa Loa:
- West Africa, rural areas
  - transmitted by deer flies
  - transient, pruritic, painful sub Q swellings lasting 1-3 wks
  - worm migration across sclera or eye-lid
  - Dx: mf in day bloods, worm extraction
  - Rx: diethylcarbamazine, albendazole
- iv. Gnathostomiasis:
- Thailand, Japan, Asia
  - *Gnathostoma spinigerum*
  - eating undercooked fresh water fish, crabs, snakes, frogs
  - Transient subQ swellings on limbs or long, pruritic serpiginous tract
  - Dx: clinical
  - Rx: albendazole

### III. ULCERS

#### i. Tropical ulcer:

1. pyoderma - 2° infected bites or skin colonization  
Dx: nasal swab C+S  
Rx mupuricin, cloxacillin or clindamycin or co-trimoxazole + rifampin
2. phagedenic - trauma, lower limb, in poor, malnourished persons
  - anerobic infection (B. fusiformis, T. vincenti)
  - rapid, painful, foul smelling -- chronic painless ulcer.
  - Rx: metronidazole (tetracycline, penicillin)

#### ii. Cutaneous leishmaniasis:

- Asia, Africa and South America
- Spectrum:
  - mucocutaneous destruction (espundia)
  - self-healing (Oriental Sore)
  - nodular plaques (DCL)
- DDx of linear ulcers: sporotrichycosis, Mycobacterium marinum
- Dx: smear, culture, biopsy
- Rx: supportive, local heat, local or systemic sodium stibogluconate (Pentostam), itraconazole, allopurinol

#### iii. Tick eschar:

- black eschar with erythematous margin
- located at clothing constrictions
- tick typhus (Mediterranean, African, Indian)
- scrub typhus (S.E. Asia)

#### iv. Cutaneous tuberculosis: (Lupus vulgaris)

- females > males
- plaques, nodules, ulcers, "apple jelly" nodules on face and neck;  
TB elsewhere
- regional adenopathy

### IV. LINEAR

#### I. Cutaneous larva migrans:

- very pruritic linear, serpigenous lesions; occasionally bullous
- Rx: topical or oral thiabendazole, albendazole, ivermectin

- suspect strongyloidiasis (larva currens);
  - perianal larval track
  - rapid migration, up to 10 cm/hr
  - prolonged symptoms

ii. Phytophotodermatitis:

- psoralen containing compounds (lime juice) which cause UVA photosensitization
- painless, erythematous, pigmented, straight streaks or droplets.

V. *HYPOPIGMENTED*

i. Tinea versicolor (Malassezia furfur):

- hyper or hypopigmented, well-defined macules with fine scales; upper trunk
- Dx: cellulose acetate tape with methylene blue
- Rx: clotrimazole, ketoconazole, selenium sulphide (selsun shampoo)

ii. Leprosy:

- spectrum:
  - TT (few asymmetrical, well-defined anesthetic patches)
  - BB (multiple nerves, circinate lesions)
  - LL (multiple, symmetrical, ill-defined, oily, nodules or patches with normal sensation)
- reactions:
  - a. Reversal/downgrading: gradual onset, neuritis erythematous, desquamating nodules and plaques, arthritis (BT ↔ LL)  
Rx: prednisone, cyclosporin A
  - b. ENL: sudden onset, crops of transient, painful nodules, plaques, fever, neuritis, iridocyclitis, arthritis, orchitis (BL, LL)  
Rx: prednisone, thalidomide, clofazimine, cyclosporin A
- Clinical: nerve thickening + anesthetic patch
- Dx: slit skin smears, deep Bx of skin or nerve
- Rx: TT, BT: dapsone, rifampin x 6 mo.  
BB-LL: dapsone, rifampin, clofazimine or ethionamide x 2 yrs. or smear (-)
- New drugs: ofloxacin, minocycline, clarithromycin

## VI. AQUATIC: (appendix 3)

### i. Sea urchin spines, (echinoderms)

- body covered with venomous spines and pedicellariae
- reactions:
  1. immediate; pain, edema, imbedded spine
  2. delayed; edema, cyanosis
  3. late: foreign body granuloma -- nodules
- Rx: - pain relief; hot water 45°C, 30-90 min.
  - detoxification; 5% acetic acid (vinegar)
  - scrape off pedicellariae ( shaving cream)
  - delayed; systemic steroids
  - late; intralesional steroid, excision

### ii. Cercarial dermatitis

- human and non-human schistosomes
- transient papular, vesicular, urticarial rash on exposed areas
- onset min. to hrs. after exposure; lasts up to 1 week
- Rx: antihistamines, topical or systemic steroids

### iii. Sea-bather's eruption (sea-lice)

- Florida, Caribbean, Bermuda, Long Island
- larvae of sea anemone (*E. lineata*) and jelly-fish (*L. unguiculata*)  
*Cnidaria*
- increasing epidemics since 1981
- onset <24 hrs and lasting up to 4 wks (av. 3-12 d.)
- pruritic inflammatory papules (85%) → pustules (25%) → vesicles (9%) ± urticarial plaques (11%) in bathing suit distribution
- needle-like stinging sensation especially with friction from nematocysts
- fever, headache, nausea, esp. in children
- Bx: sup. & deep perivascular and interstitial infiltrate with lymphs, eos. and PMNS.
- Rx: antihistamines, topical & systemic steroids, isopropyl alcohol, vinegar

- iv. Coelenterate dermatitis: (jelly fish, portuguese man -of-war)
- nematocytes remain in skin and fire off toxin-containing barb; triggered by fresh water and rubbing.
  - stinging, burning, numbness
  - linear, urticarial, vesicular, or ulcerative; post-inflammatory hyperpigmentation
  - Rx: - rinse in sea water; avoid fresh water;
    - 5% acetic acid (vinegar) to inactivate toxin
    - remove tentacles, shaving cream and scrape
    - severe cases: tourniquets, steroids and epinephrine
- v. Wound infections:
- a. marine: gram neg. bacilli esp. *Vibrios*
    - 3rd generation cephalosporins (cefotaxime etc.)
    - quinolones (ciprofloxacin etc.)
    - TMP/SMZ, tetracycline
  - b. fresh water: gram neg. bacilli esp. *Aeromonas*
    - as for marine organisms

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J.S. Keystone  
June, 1995

Table 1: Epidemiology of Tropical Skin Disorders

Activity (Exposure)	Disease
1. Animal contact	anthrax, tick eschar tularemia
2. Barefoot-walking	cutaneous larva migrans, hook-worm, strongyloidiasis, tungiasis
3. Fresh water contact	cercarial dermatitis <u>M. marinum</u>
4. Sea (salt) water swimming	sea urchin, coral, jelly-fish stings, Portuguese-man-of-war, sea bather's eruption, seaweed dermatitis. <u>M. marinum</u>
5. Drying clothes on ground	myiasis
6. Skin Trauma	sporotrichosis, <u>M. marinum</u> , tropical phagaedenic ulcer, ecthyma, maduramycosis, chromomycosis, Buruli ulcer, pyoderma gangrenosa.
7. Insect exposure:	
Sand fly (rural rainforest or arid areas)	leishmaniasis
Black fly (fast moving rivers)	onchocerciasis
Tse tse fly (rivers and Savannah)	trypanosomiasis
Deer fly (rural rainforests)	loa Loa
Blister beetle	blister beetle dermatitis
Butterfly moth	Butterfly moth dermatitis
8. Eating undercooked fish or seafood	gnathostomiasis
9. Personal contact	tuberculosis, leprosy, diphtheria, yaws, pinta syphilis
10. Antibiotic (tetracycline) perfumes	photodermatitis
11. Plants, lime juice	phytophotodermatitis, plant dermatitis
12. Walking in long grass	mite, snake and tick bites.



Table 7: Tropical Dermatology Quick Reference: Differential Diagnosis

## 1. Macules

hyperpigmented  
 phytophotodermatitis  
 post-inflammatory  
 hypopigmented  
 leprosy  
 onchocerciasis  
 pinta  
 pityriasis alba  
 post-inflammatory  
 post-Kala Azar dermal leishmanoid  
 tinea corporis  
 tinea versicolor  
 vitiligo

## 2. Vesiculo-bullous

blister beetle dermatitis  
 bullous impetigo  
 butterfly moth dermatitis  
 cutaneous larva migrans  
 herpes simplex  
 herpes zoster  
 photodermatitis  
 phytophotodermatitis  
 sunburn

5. Subcutaneous Swellings\*  
or Nodules

cysticercosis  
 gnathostomiasis\*  
 leprosy  
 loa loa \*  
 maduromycosis  
 Mycobacterium marinum  
 myiasis  
 onchocerciasis  
 paraccoidiodomycosis  
 sea urchin spines  
 tungiasis

## 2. Papules

cercarial dermatitis  
 dermatophytosis  
 drug reaction  
 dyshydrotic eczema  
 insect bites  
 miliaria  
 myiasis  
 onchocerciasis  
 photodermatitis  
 scabies  
 sea bather's eruption  
 seaweed dermatitis  
 streptocerciasis  
 tungiasis

## 4. Linear

blister beetle dermatitis  
 cutaneous larva migrans  
 flea bites  
 gnathostomiasis  
 larva currens (strongyloidiasis)  
 leishmaniasis  
 Mycobacterium marinum  
 myiasis  
 photodermatitis  
 phytophotodermatitis  
 sporotrichosis

## 6. Ulcers

anthrax  
 diphtheria  
 ecthyma  
 leishmaniasis  
 mycobacterium marinum  
 neurotrophic (leprosy)  
 pyoderma gangrenosum  
 syphilis  
 tick eschar  
 tropical phagaedenic  
 tuberculosis  
 yaws

Table 7: Tropical Dermatology Quick Reference: Differential Diagnosis  
(Continued)

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### 7. Vegetating & Verrucous

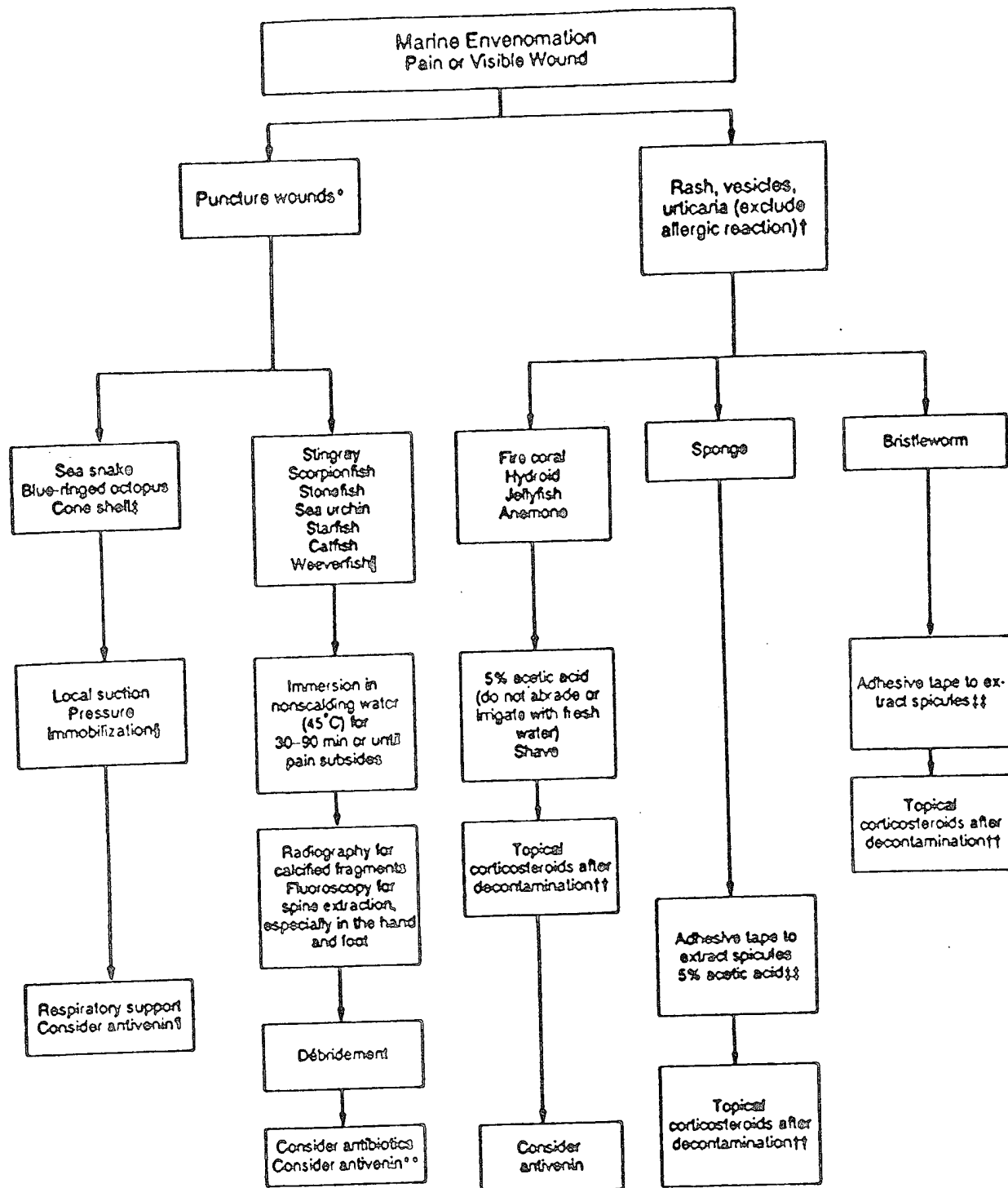
bartonellosis  
chromomycosis  
histoplasmosis  
leishmaniasis  
leprosy  
maduromycosis  
Mycobacterium marinum  
paraccoidiomycosis  
pinta  
schistosomiasis  
syphilis  
tuberculosis  
yaws

### 8. Pruritic Lesions

cercarial dermatitis  
cutaneous larva migrans  
drug reaction  
enterobiasis  
gnathostomiasis  
insect bites  
larva currens (strongyloidiasis)  
loiasis  
onchocerciasis  
phytodermatitis  
scabies  
sea bather's eruption  
seaweed dermatitis  
streptocerciasis

### 9. Migratory Lesions

cutaneous larva migrans  
fascioliasis  
gnathostomiasis  
larva currens (strongyloidiasis)  
loiasis  
myiasis  
paragonimiasis  
sparganosis



Marine Envenomations, Auerbach, PS, NEJM 325:486-493,1991

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Friday, August 11, 1995

# STDs

*Elaine Jong, MD*

**Second World Congress on Wilderness Medicine.  
Session 41.**

**SEXUAL RISK TAKING WHILE TRAVELING**

Elaine C. Jong, MD  
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**OBJECTIVES:** Following this presentation, participants will be able to: 1) Identify the risks of STDs while traveling; 2) Identify the STDS more common in tropical and developing countries; 3) Give pre-travel advice for safe sexual practices.

**I. Who is at risk?**

Factors associated with casual sex abroad:

- A. Single or traveling without spouse or regular partner
- B. Young age
- C. Male
- D. Long stay
- E. Occupation
  - 1. Tourist
  - 2. Military
  - 3. Overseas workers
  - 4. Volunteer relief worker

**II. Who are the sexual partners during travel?**

- A. The boy or girl next door
  - Short stay tourists-- partner is fellow traveler
- B. "National Geographic"-- amateur host country nationals
- C. Commercial sex workers

**III. Who is responsible?**

- A. The traveler--
  - 1. Planned vs. unplanned
  - 2. Romantic fantasies associated with travel
  - 3. Personal behavior-- especially alcohol use
- B. The host country
  - 1. Economic realities
    - a. Lack of education
    - b. High rate of prostitution
    - c. High rate of genital ulcerative diseases
    - d. Lack of treatment programs
    - e. Large populations of immigrants and refugees
  - 2. Regulation of CSWs: good or bad?
    - a. Drug resistance in STDS
    - b. Exploitation
- C. The travel industry
  - 1. Singles tours
  - 2. Sexual tourism

III. Geography of STDS Global Annual Occurrence\*

A. Some STDS familiar in the U.S. may be more prevalent in some developing countries

1. Gonorrhea (*Neisseria gonorrhoeae*) (25 million)\*
  - a. Dysuria/urethral discharge
  - b. 1 million cases/yr in U.S.
2. Chlamydia (*Chlamydia trachomatis*) (50 million)\*
  - a. Dysuria/urethral discharge/  
mucopurulent cervicitis
  - b. 3-5 million cases/yr in U.S.
3. Herpes simplex virus (HSV-2)
  - a. Painful genital ulcers
  - b. Up to 25% of U.S. population  
is infected by HSV-2 by  
age 30
  - c. 20-40 million in U.S.\*\*
4. Human papilloma virus (HPV) (30 million)\*
  - a. Anogenital wart: Types 6,11  
(Condyloma acuminatum)
  - b. Cervical carcinoma: Types 16,18
5. Syphilis (*Treponema pallidum*) (3,5 million)\*
  - a. Painless genital ulcer
  - b. Uncommon in the U.S. except in  
certain risk groups:
    - 1) Homosexual males
    - 2) Prostitutes
    - 3) Immigrants from developing  
countries
    - 4) HIV-infected persons
  - c. <100,000 cases/yr in U.S.

B, STDS on the rise

1. HIV-1 (1 million)\*
  - a. Cumulative worldwide prevalence  
in late 1994: 13-15 million+
  - b. May progress to AIDS
  - c. Heterosexually-transmitted HIV
    - 1) 9 % of U.S.AIDS cases\*\*\*
    - 2) 75% of worldwide HIV infections
  - d. Pattern of rapid spread of HIV  
infection in Asia & SE Asia  
involves intravenous drug users  
then female prostitutes, then  
male clients of prostitutes,  
then in their wives, pregnant  
women, subsequently children

2. HIV-2
  - a. May progress to AIDS
  - b. West Africa
  - c. Sporadic cases in other countries
3. HLV-1
  - a. Adult T-cell leukemia, tropical spastic paresis
  - b. Japan, Caribbean, Papua New Guinea
  - c. Sporadic cases in South America, central Africa
4. Hepatitis B
  - a. Acute hepatitis may progress to chronic active hepatitis
  - b. Higher rate of asymptomatic carriers among people of foreign origin and special occupational, institutionalized, and behavior risk groups

C. STDS in tropical and developing countries

1. Chancroid (*Haemophilus ducreyi*) ( 2 million)\*
  - a. Painful ulcer often followed by unilateral bubo (supportive lymph node)
  - b. Africa, the Far East, Central & South America, the Caribbean
2. Lymphogranuloma venereum (LGV) (LGV strains of *Chlamydia trachomatis*)
  - a. Painless ulcer followed by matted rubbery adenopathy, usually unilateral
  - b. Africa, the Far East, South America, & the Caribbean
3. Granuloma inguinale (*Calymmatobacterium donovani*)
  - a. Subcutaneous nodules followed by ulcerative lesions; the ulcers have a rolled edge appearance and are often indistinguishable from the other genital ulcerative diseases
  - b. The Caribbean, India, Oceania (in Papua New Guinea & among northern Australian aborigines); less common in Africa & South America

\* World Health Organization, 1991

+ World Health Organization, 1994

\*\* Reliable data not available for developing countries

\*\*\* CDC, 1993

#### IV. Identifying the HIV infection risk factors

- A. Demographics: unprotected sex with a high risk partner
  - 1. Homosexual male
  - 2. Injecting-drug use
  - 3. Heterosexual sex
    - a. Multiple sex partners
    - b. Concurrent STDs
    - c. Being sexually active in areas with a high rate of HIV among drug users
    - d. Sex with a prostitute
  - 3. Tranfusion Recipient
  - 4. Person with hemophilia
- B. Inconsistent condom use

#### V. Lowering the risk

- A. Individuals
  - 1. Pre-travel advice: make sure the traveler is informed about the risks and the safeguards
  - 2. Selection of sexual partners: HIV infectivity during a single act of sexual intercourse
    - a. Female to male: 0.001
    - b. Male to female: 0.01
  - 3. Use barrier protection (condoms)
    - a. Condom lowers risk of HIV transmission 10-100 fold
    - b. Genital ulcerative disease raises rate of transmission approx. 2.5 fold
  - 4. Be prepared
    - a. Take along high quality U.S. made latex condoms
    - b. Hepatitis B vaccine
    - c. Sterile needles and syringes
  - 5. Abstinence
  - 6. Beware of alcohol and other mind-altering substances
- B. Receiving countries
- C. Travel industry



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## THE CENTERS FOR DISEASE CONTROL AND PREVENTION: SEXUALLY TRANSMITTED DISEASES TREATMENT GUIDELINES

### INTRODUCTION

Physicians and other health-care providers have an essential role in the evaluation, management, and prevention of sexually transmitted diseases (STDs). To help assist with this effort, the Division of STD/HIV Prevention of the Centers for Disease Control and Prevention (CDC), in consultation and cooperation with experts in the area and concerned organizations, periodically reviews and updates its recommendations for treatment of patients with STD.

In 1993, CDC staff systematically reviewed the scientific literature on each of the major STDs, focusing on data and reports that have become available since 1989, when the Guidelines were last updated. The CDC then convened an expert panel to evaluate the literature, focusing on the four principal outcomes of STD therapy: 1) microbiologic cure; 2) alleviation of signs and symptoms; 3) prevention of sequelae; and, 4) prevention of transmission.

From this process, the CDC developed its revised 1993 STD Treatment Guidelines.

This issue of *Clinical Courier*® highlights the 1993 Guidelines, with emphasis on the most common syndromes and on those recommendations that differ from the 1989 Guidelines. These include: treatment of uncomplicated gonococcal and chlamydial infections; new treatments for bacterial vaginosis; outpatient management of pelvic inflammatory disease (PID); and new patient-applied medication for the treatment of genital warts.

The Treatment Guidelines also contain new sections on sub-clinical human papillomavirus infections. The content of this *Clinical Courier*® has been reviewed by the CDC's Division of STD/HIV Prevention.

### GONOCOCCAL INFECTIONS

There are an estimated 1 million new infections with *Neisseria gonorrhoeae* in the United States each year. As for most STDs, women are far more likely than men to have serious short- and long-term sequelae. Most infected men have symptoms causing them to seek treatment, usually soon enough to prevent serious sequelae – but not always early enough to prevent transmission to sex partners. Women infected with gonorrhea are often asymptomatic, or have mild or nonspecific symptoms, until complications such as PID supervene.

Several antibiotic regimens are safe and effective, eliminating *N. gonorrhoeae*, preventing transmission, relieving symptoms, and reducing the chance for sequelae. Resistance of gonococcal strains to penicillin, ampicillin, amoxicillin, and the tetracyclines is common throughout the United States; none of these drugs should be used to treat gonorrhea.

The recommended treatment regimens for uncomplicated gonococcal infections are outlined in Table 1. All offer 98% microbiologic and clinical efficacy for genital and rectal gonorrhea.

Ceftriaxone in a single injection of 125 mg produces sustained, high bactericidal blood levels. Before 1993, 250 mg was the recommended dose, but 125 mg clearly is sufficient. The major disadvantages of ceftriaxone are the need for IM injection and somewhat higher cost than the other options.

Cefixime, which can be administered orally, has an antimicrobial spectrum similar to that of ceftriaxone. It does not produce as high or as sustained bactericidal blood levels as ceftriaxone 125 mg, and its efficacy for pharyngeal gonorrhea may be less than for the other regimens. However, clinical efficacy for anogenital infection is excellent.

Ciprofloxacin 500 mg produces sustained bactericidal blood levels and is safe and effective for uncomplicated gonorrhea at all anatomic sites. It is the least expensive of the recommended options. Ofloxacin in single oral doses of 400 mg is also highly effective for the treatment of uncomplicated anal and genital gonorrhea, and cures ≥80% of pharyngeal infections. As for all quinolones, neither ciprofloxacin nor ofloxacin should be used in patients <18 years of age, and both are contraindicated during pregnancy.

Up to 40% of persons with gonorrhea also are infected with *Chlamydia trachomatis*. Therefore, regardless of the initial single-dose regimen given, follow-up therapy with a regimen active against *C. trachomatis* should be prescribed. Dual therapy also may retard the selection and spread of antibiotic-resistant gonococci.

**Table 1**  
**Treatment Regimens for Uncomplicated**  
**Gonococcal Infections**

**A single dose of:**

- Ceftriaxone 125 mg IM, or
- Cefixime 400 mg orally, or
- Ciprofloxacin 500 mg orally, or
- Ofloxacin 400 mg orally

**PLUS**

- A regimen effective against coinfection with *C. trachomatis*, such as doxycycline 100 mg orally 2 times/day for 7 days

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## CHLAMYDIAL INFECTIONS

Since genital chlamydial infection is common in the U.S. and is frequently asymptomatic, routine testing in sexually active young women – especially teenagers – should be performed during all gynecologic examinations, even if symptoms are not present. The recommended and alternative treatment regimens identified in Table 2 relieve symptoms, cure infection, and prevent transmission. Of particular note is the recent availability of a single-dose regimen, azithromycin (1 g) orally, for the management of chlamydia. This is an important development, but the single-dose advantage is partly offset by the greater expense of azithromycin.

Doxycycline and azithromycin are similar in efficacy. Doxycycline has a longer history of use and costs less. Ofloxacin, 300 mg BID for 7 days, is also an effective option when neither doxycycline nor azithromycin can be given. Before the 1993 Guidelines, the other major option was erythromycin, 2 g daily in divided doses, but gastrointestinal intolerance often limited compliance. This is not a problem with ofloxacin, which is much better tolerated. For most infections, the quinolones are interchangeable. Clinicians should note that ciprofloxacin therapy does not reliably cure chlamydial infection, and should not be used. Treatment of chlamydia in pregnancy remains the main indication for use of the erythromycin regimen. Both doxycycline and ofloxacin are contraindicated in pregnancy, and the efficacy and safety of azithromycin are uncertain. Amoxicillin may be used by pregnant patients who cannot tolerate erythromycin.

Sex partners of patients with chlamydia should also be referred for evaluation and treatment. This is necessary in order to prevent reinfection of the index patient, complications in the partners, and transmission to other persons.

## GENITAL ULCER DISEASE: HERPES, SYPHILIS, AND CHANCROID

Among sexually active young persons in most areas of the U.S., genital herpes accounts for an estimated 50% to 70% of genital ulcer disease, and primary syphilis for about 10% to 20% of cases. Chancroid accounts for only 0% to 5% of cases, except in selected cities where it is common. Thus, the main differential diagnosis in young, sexually active patients with genital ulcers is between genital herpes and syphilis.

Many cases of genital herpes, perhaps a majority, do not present with classical lesions, such as tender, grouped vesicles, pustules, or ulcers; "nonspecific" ulcers probably are more common. Similarly, although primary syphilis classically presents with a nontender, indurated lesion, atypical lesions are common. For these reasons, all sexually active young adults and teenagers with genital ulcers should be evaluated for both infections, including a serological test for syphilis and a culture or other lesion test for herpes simplex virus – regardless of the appearance of the lesion. A darkfield examination for *Treponema pallidum* is indicated if syphilis is suspected.

Chancroid typically presents with one or more tender, non-indurated lesions with purulent bases, often with undermined edges. Tender, fluctuant inguinal lymphadenopathy occurs in up to half the cases. Patients with this clinical picture should be cultured for the causative agent, *Haemophilus ducreyi*, as should those who were sexually exposed in settings where chancroid is common.

Ideally, treatment should be based on definitive diagnosis. In order to maximize clinical benefit and prevent further transmission, it is often necessary to initiate therapy for the most likely diagnosis while awaiting the results of diagnostic tests.

**Table 2**  
**Treatment Regimens for Chlamydia**

### Recommended:

- Doxycycline 100 mg orally 2 times/day for 7 days,
- Azithromycin 1 g orally in a single dose

### Alternatives:

- Ofloxacin 300 mg orally 2 times/day for 7 days,
- or
- Erythromycin base 500 mg orally 4 times/day for 7 days,\*
- or
- Erythromycin ethylsuccinate 800 mg orally 4 times/day for 7 days,\*
- or
- Sulfisoxazole 500 mg orally 4 times/day for 10 days\*

\*These regimens are less effective than the others; test-of-cure is indicated 2 – 3 weeks after the patient completes treatment.

## Treatment of Genital Herpes

Oral acyclovir is the drug of choice for treatment of patients with their first episodes of genital herpes (Table 3a). Episodic treatment of recurrences provides little benefit, but ongoing suppressive therapy reduces the frequency and severity of recurrences for many patients. Topical acyclovir provides little benefit and should be prescribed rarely, if ever.

## Treatment of Primary Syphilis

Penicillin remains the drug of choice for all stages of syphilis. The standard regimen for primary, secondary, or latent syphilis of less than 1 year's duration is benzathine penicillin G in a single IM injection of 2.4 million units (Table 3b). Individuals with latent syphilis of more than 1 year's duration, or of unknown duration, should receive 3 doses of 2.4 million units IM, one week apart.

## Treatment of Chancroid

Three regimens are recommended for treating chancroid (Table 3c). Ceftriaxone 250 mg in a single dose has been widely employed, but has the disadvantages of IM administration and markedly reduced efficacy in the presence of HIV infection – a common occurrence in patients with chancroid. Azithromycin 1 g has the advantages of single-dose treatment and oral administration, but is more expensive. The erythromycin regimen is effective but requires compliance with 7 days' treatment, and often causes gastrointestinal side effects. The alternative treatments, amoxicillin/clavulanic acid for 7 days, or ciprofloxacin for 3 days, are likely to be effective, but experience in the United States is limited. Azithromycin and ciprofloxacin should be avoided in pregnant women, and ciprofloxacin should not be given to persons under age 18.

Fluctuant inguinal lymphadenopathy sometimes progresses despite otherwise effective antibiotic therapy, but this is not necessarily a sign of treatment failure. In such cases, needle aspiration prevents spontaneous rupture and speeds clinical resolution; repeat aspirations are sometimes necessary.

## BACTERIAL VAGINOSIS

Bacterial vaginosis (BV) is the result of the replacement of normal H<sub>2</sub>O<sub>2</sub>-producing *Lactobacillus* spp in the vagina with high concentrations of anaerobic bacteria (e.g., *Bacteroides* spp, *Mobiluncus* spp), *Gardnerella vaginalis*, and *Mycoplasma hominis*. This syndrome is the most common cause of vaginal odor, and one of the most common causes of increased vaginal discharge. About 50% of women with clinical criteria for BV do not have symptoms. The cause of the microbial alterations is not fully understood, and treatment of the male sex partner has not proven helpful in preventing recurrence. Although closely linked with sexual activity, there is no evidence that BV results from exogenous acquisition of any particular microorganism.

Relief of symptoms and signs is the primary objective of treatment, so only those patients with symptoms need therapy. However, some clinicians routinely treat women with florid signs of BV, even if these patients deny symptoms of odor or increased discharge. This is due to the likelihood that BV sometimes contributes to development of PID and adverse outcomes of pregnancy. The male sex partners are asymptomatic, and because their treatment has not been shown to alter either the clinical course of BV in women or their relapse/reinfection rate, prevention of transmission is not a goal of BV treatment.

Table 3

### Genital Ulcer Disease: Treatment Guidelines

#### 3a. Genital Herpes

First Clinical Episode: Acyclovir 200 mg orally 5 times a day for 7 – 10 days (or until clinical resolution is attained)\*

Daily Suppressive Therapy for Frequent Recurrences (≥ 6 per year)

Recommended Regimen:  
Acyclovir, 400 mg orally 2 times/day

Alternative Regimen:  
Acyclovir, 200 mg orally, 3 to 5 times/day†

\*Some clinicians prescribe 400 mg 3 times/day for 7 – 10 days.

†The goal of the alternative regimen is to identify for each patient the lowest dose that provides relief from frequently recurring symptoms.

#### 3b. Syphilis

- Patients with primary or secondary syphilis, or latent syphilis of less than 1 year's duration, should receive:
  - Benzathine penicillin G, 2.4 million units IM in a single dose
- Patients with latent syphilis of more than 1 year's duration, or of unknown duration, should receive:
  - Benzathine penicillin G, 7.2 million units IM, given as 3 doses of 2.4 millions units, 1 week apart

#### 3c. Chancroid

##### Recommended:

- Ceftriaxone 250 mg IM, in a single dose,  
or
- Azithromycin 1 g orally, in a single dose,  
or
- Erythromycin base 500 mg orally 4 times/day for 7 days

##### Alternatives:

- Amoxicillin 500 mg plus clavulanic acid 125 mg orally 3 times/day for 7 days,  
or
- Ciprofloxacin 500 mg orally 2 times/day for 3 days

\*Efficacy substantially reduced in HIV-infected patients.

The recommended therapy is metronidazole 500 mg, orally, 2 times/day for 7 days (Table 4). Treatment with metronidazole 2 g, orally, in a single dose is useful for women who may not comply with a 7-day regimen, but is associated with a higher recurrence rate. Recurrence of BV is common; however, no long-term maintenance regimen has been evaluated. The other alternatives include vaginal therapy with clindamycin or metronidazole. Although experience is limited, some experts believe that one or both of these regimens will become the treatment of choice. Oral clindamycin also is an effective option.

Many clinicians have tried to treat BV and other vaginal infections with vaginal douches. However, recent studies show that douching, even for "routine hygiene," is a potent risk factor for PID and ectopic pregnancy. While many women may douche because of symptoms of BV or other vaginal infections, douching has never been shown to effectively prevent or treat any infection. Therefore, clinicians should advise young, sexually active women that douching is ineffective, and that the symptoms that patients may associate with poor hygiene (e.g., odor, vaginal discharge) are indications for an examination by a health-care professional.

## PELVIC INFLAMMATORY DISEASE

Pelvic inflammatory disease (PID) encompasses a range of inflammatory conditions of the upper female genital tract, including any combination of endometritis, salpingitis, tubo-ovarian abscess, and pelvic peritonitis (Figure 1). Symptomatic PID results in an estimated 2.5 million outpatient visits annually to physicians. Additionally, more than 275,000 women are hospitalized, and more than 100,000 surgical procedures performed yearly as a consequence of PID. Early diagnosis and effective management of PID probably help to prevent sequelae, which include infertility due to tubal occlusion, ectopic pregnancy, and chronic pelvic pain. Most cases are caused by *N. gonorrhoeae* or *C. trachomatis*; however, microorganisms that occur in the vaginal flora, such as anaerobes, *Gardnerella vaginalis*, *Haemophilus influenzae*,

**Figure 1**  
**Pelvic Inflammatory Disease**



enteric gram-negative rods, and *Streptococcus* species, can also cause PID, either alone or as superinfecting bacteria. Some experts believe that *Mycoplasma hominis* and *Ureaplasma urealyticum* also contribute to PID. Initial episodes of acute PID are especially likely to be due to gonorrhea or chlamydia infection, whereas repeat episodes and cases associated with an intrauterine contraceptive device often are due to nonsexually transmitted pathogens.

There is a wide range of symptoms and signs in women with PID, making the diagnosis difficult; it is usually made on clinical judgment. Many occurrences of PID go unrecognized and therefore untreated because there are no symptoms, or because the health-care provider fails to appreciate the implications of mild or nonspecific symptoms or signs, such as abnormal bleeding, dyspareunia, vaginal discharge, or mild abdominal pain. As a consequence of the difficulty in diagnosis and the potential reproductive health damage of PID, health-care providers should increase their index of suspicion for PID. It is probably better to overtreat and overdiagnose suspected PID than to permit mild or atypical cases to go untreated. The difficulties inherent in diagnosing PID as a consequence of its often asymptomatic or atypical presentation have led the CDC to develop two sets of clinical criteria for a diagnosis of PID: The **MINIMUM** criteria for empiric antimicrobial treatment of PID are intended for use in young, sexually active women at risk for STD. They include the presence of *all* of the following: 1) lower abdominal tenderness, 2) adnexal tenderness, 3) cervical motion tenderness.

For older women or others who do not seem to be at high risk for STD, many experts would add a requirement for evidence of a lower genital tract infection, such as cervicitis or bacterial vaginosis.

For women with severe clinical signs, more elaborate diagnostic evaluation is called for to help reduce morbidity. The presence of one or more of the following **ROUTINE** criteria increases the specificity of the clinical diagnosis: oral temperature  $>38.3^{\circ}\text{C}$  ( $100.9^{\circ}\text{F}$ ); abnormal cervical or vaginal discharge; elevated erythrocyte sedimentation rate; elevated C-reactive protein; laboratory documentation of cervical infection with *N. gonorrhoeae* or *C. trachomatis*.

The **ELABORATE** criteria for PID, any one of which firmly establishes the diagnosis, include: histopathologic evidence of endometritis on endometrial biopsy; tubo-ovarian abscess on sonography; laparoscopic abnormalities consistent with PID.

**Table 4**  
**Treatment of Bacterial Vaginosis**

### **Recommended**

Metronidazole\* 500 mg orally 2 times/day for 7 days

### **Alternative**

Metronidazole\* 2 g orally in a single dose

*The following alternative regimens have been effective in clinical trials, although experience to date is limited:*

Clindamycin cream, 2%, one full applicator (5 g) intravaginally at bedtime for 7 days

or

Metronidazole gel, 0.75%, one full applicator (5 g) intravaginally, 2 times a day for 5 days

or

Clindamycin 300 mg orally 2 times a day for 7 days

\*Patients should be advised to avoid using alcohol during treatment with metronidazole, and for 24 hours thereafter.

Empiric, broad-spectrum coverage of likely pathogens for PID treatment regimens is essential. Such antimicrobial therapy should cover *N. gonorrhoeae*, *C. trachomatis*, gram-negative facultative bacteria, anaerobes, streptococci, and the genital mycoplasmas. No single therapeutic regimen has been established as optimal for the treatment of PID. The specific treatment regimen chosen will depend on a number of factors, including antimicrobial susceptibility, cost-control concerns, and patient acceptability.

Presently, there are few data available as to the risks, benefits, and costs associated with inpatient versus outpatient treatment for PID patients. Hospitalization and treatment with parenteral antibiotic therapy is recommended by many experts for all patients who are concerned about the preservation of their fertility. In addition, the 1993 CDC Guidelines recommend that patients be hospitalized if: 1) the diagnosis is uncertain, e.g., if ectopic pregnancy or appendicitis cannot be reliably excluded; 2) a pelvic abscess is suspected; 3) the patient is pregnant; 4) the patient is an adolescent (due to unpredictable compliance with treatment and follow-up); 5) severe illness or nausea and vomiting precludes outpatient treatment; 6) the patient is unable to follow or tolerate therapy; 7) substantial clinical improvement is not observed within 72 hours of starting antibiotic treatment; and, 8) it is not possible to arrange clinical follow-up within 72 hours of starting antibiotic treatment.

PID can be difficult to treat due to the bimodal nature of the infection, i.e., a woman may have an initial gonococcal or chlamydial infection, then be superinfected with anaerobes or other vaginal bacteria. Neither clinical assessment nor the results of cervical cultures predicts with certainty which of these pathogens is contributing to pelvic inflammation in any individual patient. Thus, recommended inpatient and outpatient regimens provide coverage against all of the likely pathogens, and usually result in clinical resolution of acute PID. No data are available to assess the efficacy of any regimen in preventing long-term complications such as infertility and ectopic pregnancy. Consequently, treatment of every patient must be directed towards all of these organisms.

**Table 5**  
**PID Treatment: Inpatient Regimens**

**Regimen A**  
Cefoxitin 2 g IV every 6 hours  
or  
Cefotetan 2 g IV every 12 hours  
**PLUS**

Doxycycline 100 mg orally or IV every 12 hours  
The above regimen should be continued for at least 48 hours after the patient shows significant clinical improvement. After hospital discharge, doxycycline 100 mg orally 2 times/day should be continued to complete a total of 14 days of therapy.

**Regimen B**  
Clindamycin 900 mg IV every 8 hours  
**PLUS**

Gentamicin loading dose IV or IM (2 mg/kg) followed by 1.5 mg/kg IV or IM every 8 hours  
The above regimen is given for at least 48 hours after the patient shows significant clinical improvement. After hospital discharge, either doxycycline 100 mg orally twice a day, or clindamycin 450 mg 4 times/day, should be continued to complete 14 days total of antibiotic therapy.

## Inpatient Treatment

Experts have experience with and clinical evidence of the short-term efficacy for both of the regimens outlined in Table 5. Regimen A should be continued for at least 48 hours after the patient has shown substantial clinical improvement, after which doxycycline, 100 mg orally 2 times/day, should be continued to complete a total of 14 days of antibiotic therapy.

Regimen B, as with Regimen A, should be continued for at least 48 hours after the patient has shown some substantial clinical improvement, followed by doxycycline 100 mg orally 2 times/day, or clindamycin 450 mg orally 4 times/day, to complete a total of 14 days of therapy. Because it provides more effective anaerobic coverage, clindamycin is recommended by many experts for continued therapy when a tubo-ovarian abscess is evident.

Limited clinical data support alternate inpatient regimens; however, two treatment regimens that have broad-spectrum coverage have been studied in at least one clinical trial. Ampicillin/sulbactam plus doxycycline appears to be effective in patients with tubo-ovarian abscess, and has good anaerobic coverage. Intravenous ofloxacin, which is highly active against *N. gonorrhoeae*, *C. trachomatis*, and most aerobic and facultative bacteria, has been studied as a single agent and appears effective. However, it provides inadequate coverage for anaerobic pathogens, and most experts would use IV ofloxacin only in combination with clindamycin or metronidazole.

## Outpatient Treatment

The two outpatient regimens outlined in Table 6 provide coverage against most of the common etiologic agents of PID. However, recent data show that doxycycline is less active than previously believed against the anaerobic pathogens most commonly involved in PID, and short-term clinical failure rates may approach 30%. Nevertheless, there have been many years of clinical experience with Regimen A, an initial dose of cefoxitin or ceftriaxone IM followed by 14 days of doxycycline orally. When patients do not respond to outpatient treatment within 72 hours, they should be hospitalized to reassess the diagnosis of PID and to receive parenteral therapy.

Oral ofloxacin is active against both *N. gonorrhoeae* and *C. trachomatis*, and short-term clinical response of PID was demonstrated for ofloxacin monotherapy in one study. Nevertheless, to enhance ofloxacin's anaerobic coverage, it is recommended that clindamycin or metronidazole be added -

**Table 6**  
**PID Treatment: Outpatient Regimens**

**Regimen A**  
Cefoxitin 2 g IM plus probenecid 1 g orally in a single dose concurrently, or ceftriaxone 250 mg IM or other parenteral 3rd-generation cephalosporin (e.g., ceftizoxime or cefotaxime)

**PLUS**

Doxycycline 100 mg orally 2 times/day for 14 days

**Regimen B**  
Ofloxacin 400 mg orally 2 times/day for 14 days

**PLUS**

Either clindamycin 450 mg orally 4 times/day, or metronidazole 500 mg orally 2 times/day for 14 days

thus providing the basis for the all-oral Regimen B.\* Clindamycin, but not metronidazole, also adds to the gram-positive coverage of the ofloxacin regimen. Metronidazole is administered twice daily (instead of 4 times daily for clindamycin), perhaps enhancing therapeutic compliance. Regimen B is more expensive than Regimen A; if its broader antimicrobial spectrum results in a higher cure rate or fewer long-term complications, it may be more cost effective than Regimen A.

Since there is a high risk of persistent infection in PID, particularly with *C. trachomatis*, patients need to have a microbiological reexamination 7–10 days after completing the initial treatment; this is especially important if the patient's compliance in completing treatment is in question. Some experts also suggest re-screening for both *C. trachomatis* and *N. gonorrhoeae* 4–6 weeks after completing therapy, because many women with PID will be reexposed to untreated sex partners. Sex partners of women with PID must be evaluated and treated because of the risk of reinfection, and the high likelihood of urethral gonococcal or chlamydial infection for the sex partner.

*\*Although recommended by the CDC, ofloxacin is not approved by the U.S. Food and Drug Administration for the treatment of PID.*

## HUMAN PAPILLOMAVIRUS INFECTION

### Genital Warts

Exophytic genital and anal warts are benign growths, caused by human papillomavirus (HPV), especially types 6 or 11; their main significance is cosmetic. HPV diagnoses increased fivefold between 1966–1990, probably due to both rising incidence and increasing recognition, and currently account for approximately 500,000 office visits annually in the United States. Using DNA detection methods, it has been estimated that 20% to 60% of women in STD clinics and 10% to 30% of women in family planning and student health clinics are infected with HPV.

The only goal of treatment is to remove the exophytic warts and relieve the signs and symptoms of infection, not to eliminate the HPV. No therapy has been shown to eradicate the virus, to reduce the potential for transmission, or to influence the development of cervical cancer. Randomized clinical trials have shown that most currently available genital wart treatment modalities are effective in clearing the external exophytic genital warts, with

reported efficacies ranging from 22% to 94%. However, the recurrence rates are high; all treatments are associated with recurrence rates of 25% or greater within 3 months after clearing.

There are some well-defined data that indicate small genital warts that have been present for <1 year can be treated with increased success. When left untreated, genital warts may resolve on their own (20% to 30% within 3 months), remain unchanged, or grow. Therefore, therapy for genital warts is optional, and therapeutic decisions should be made in light of patient preference. The decision as to which treatment regimen to utilize, as identified in Table 7, should take into account the anatomic site, size, and number of warts, in addition to the expense, efficacy, convenience, and potential side effects and toxicity. Patients with refractory or extensive disease should be referred to experts.

Cryotherapy with liquid nitrogen or cryoprobe is recommended for limited lesions, because it is inexpensive, does not require anesthesia, and does not result in scarring, if properly performed. Cryotherapy requires that physicians have special equipment, and most patients have mild-to-moderate pain both during and after the procedure. In four randomized clinical trials, efficacy rates of 63% to 88%, and recurrence rates of 21% to 39%, were demonstrated.

Treatment with podofilox, 0.5% solution, is relatively inexpensive, simple to use, safe, and can be self-applied by patients at home. Podofilox is purified podophyllotoxin, one of the components of podophyllin (a plant extract). In contrast to podophyllin, podofilox is a pure compound, with a stable shelf life. It also does not need to be washed off by the patient. Warts on moist mucosal surfaces often respond better than heavily keratinized warts. Mild or moderate pain and local irritation are experienced

**Table 7**  
**Treatment of External Genital/Perianal Warts**

- Cryotherapy with liquid nitrogen or cryoprobe,  
or
- Podofilox, 0.5% solution for self-treatment (**genital warts only**). Patients may apply podofilox with a cotton swab to warts twice daily for 3 days, followed by 4 days of no therapy. This cycle may be repeated as necessary for up to 4 cycles. Total wart area treated should not exceed 10 cm<sup>2</sup>, and total volume of podofilox should not exceed 0.5 mL per day. **The use of podofilox is contraindicated during pregnancy,**  
or
- Podophyllin, 10% to 25%, in compound tincture of benzoin. To avoid the possibility of problems with systemic absorption and toxicity, some experts recommend that the application be limited to 0.5 mL or 10 cm<sup>2</sup> per session. Thoroughly wash off in 1–4 hours. Repeat weekly, if necessary, for up to 6 applications. **The use of podophyllin is contraindicated during pregnancy,**  
or
- Trichloroacetic acid (TCA) 80% to 90%. Apply only to warts; powder with talc or sodium bicarbonate (baking soda) to remove unreacted acid. Repeat weekly if necessary, for up to 6 applications,  
or
- Electrodesiccation or electrocautery may be used, but not in patients with cardiac pacemakers or for lesions proximal to the anal verge.

**Figure 2**  
**Genital Warts**





by most patients after podofilox treatment. The patient must be able to see and reach the warts directly to apply the solution safely and effectively; ideally, application of the drug should be initially demonstrated by the health-care provider in the office. Five recent clinical trials showed 45% to 88% efficacy, with recurrences in 33% to 60% of patients. Podofilox is more expensive than podophyllin, but this is offset by the cost savings that result from reduced office visits.

Podophyllin treatment is inexpensive, simple to use, and safe. Compared to other therapies, a larger number of treatments may be necessary. Because of potential severe injury if the drug is misused, podophyllin should only be applied by a trained health-care provider; therefore, the low cost of the drug is counterbalanced by the cost of additional clinic visits. Mild-to-moderate pain or local irritation is experienced by most patients after treatment; as with podofilox, heavily keratinized warts will probably not respond as well as those on moist mucosal surfaces.

There are few efficacy data available on trichloroacetic acid (TCA), bichloroacetic acid (BCA), electrodesiccation, or diathermocoagulation. The latter two methods require local anesthesia, and all require treatment in the office by an experienced clinician.

Management of extensive warts, particularly in those patients who have not responded to other regimens, should utilize carbon dioxide laser and conventional surgery. None of these therapies, however, completely resolve the HPV infection.

Although intralesional or systemic therapy with interferon-alpha has been shown to have efficacy similar to that of other treatments, such treatment is not recommended by the CDC. Interferon is very expensive, has a high rate of side effects, and has no advantages over other therapies. Although 5-fluorouracil cream has been used, no controlled studies have evaluated its efficacy, and it frequently causes local irritation; it is not recommended for the treatment of genital warts.

## Subclinical Genital HPV Infection

Much more common than exophytic warts among both men and women is subclinical genital HPV infection. This infection is often indirectly diagnosed on the cervix by Pap smear, colposcopy, or biopsy. All HPV types commonly cause subclinical infection, including types 6 and 11 (which also cause overt warts) and those that are closely associated with dysplasia and cancer, such as types 16, 18, 31, and others. Although the appearance of white areas after application of acetic acid (sometimes called "acetowhitening") has been suggested as a diagnostic test for subclinical HPV infection, this test is both insensitive and non-specific; its use is not recommended. The definitive diagnosis of subclinical HPV infection requires biopsy or the detection of viral nucleic acid (DNA or RNA) or capsid proteins.

In the cervix, cell changes due to HPV are similar to those of mild dysplasia, and often regress spontaneously without treatment. Treatment is not recommended for subclinical genital HPV infection in the absence of coexistent dysplasia, because the diagnosis is often questionable, and no therapy has been shown to eliminate the infection. HPV has been shown in adjacent tissue after laser treatment of HPV-associated dysplasia, and after attempts to eradicate subclinical HPV by extensive laser vaporization in the anogenital area of men and women. For these reasons dysplasia treatment must be based on the grade of dysplasia; the presence or absence of HPV has no bearing on management. Therefore, CDC recommends that specific tests to detect subclinical HPV infection not be routinely done on Pap smears.

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Original date of release: November 1994

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This issue, "Centers for Disease Control and Prevention: Sexually Transmitted Diseases Treatment Guidelines," reports selected highlights from the Recommendations published in the Morbidity and Mortality Weekly Report of September 24, 1993 (MMWR1993;42:RR-14). This newsletter was developed and produced for the University of Washington School of Medicine on behalf of the CDC by SynerMed®, under an educational grant from Ortho-McNeil Pharmaceutical Corporation.

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# HOW RELIABLE ARE CONDOMS?

They're the best protection against sexually transmitted diseases. But several popular varieties failed our tests.

Every day some 6000 people around the world become infected with HIV, most of them through sex. In the U.S., more than a million people carry the virus that causes AIDS, and the count rises by one every 13 minutes. Nearly everyone knows how AIDS is spread—and how to stop it. Three out of four Americans now know that latex condoms, used correctly and consistently, will block AIDS and other sexually transmitted diseases, says Melissa Shepherd, who heads AIDS education efforts at the Federal Centers for Disease Control and Prevention.

Condom sales, driven by the fear of AIDS, have climbed to 450 million a year in the U.S. Once only whispered about, condoms are now routinely advertised on cable TV and in magazines, are sold in supermarkets, and come in a dizzying variety of styles. (One brand alone promotes nine varieties: lubricated, mint-scented, spermicidal, studded, sensitive, ribbed, colored, black, and snug.)

Yet many people who should use condoms still don't, apparently put off by the inconvenience or the feel. A recent survey of people with multiple sex partners, for instance, found that those who never use condoms,

or use them inconsistently, outnumbered those who always use them by 11 to 1.

Now there's more bad news: Couples who do use condoms may not be getting all the protection they think they are. How well a condom works is in good part up to the users—some people are more likely than others to break condoms through misuse. But some breakage may be due to real differences among the brands and varieties.

To assess their reliability, we bought and tested 6500 latex condoms—37 different kinds. Among our findings:

□ A half-dozen types of *Trojans*, the best-selling brand, too often flunked an air-inflation test. Long part of many other countries' condom standards, that test was adopted by U.S. inspectors last year after we bought our condoms. Had such guidelines been in place when these condoms were made, and had Government inspectors checked production lots as we did, some lots of those *Trojans* probably would not have made it out the factory door. (One variety of *LifeStyles* condoms failed the same test.)

□ Several condoms promoted as "stronger" did not do as well as others in our inflation tests. Inflating condoms checks their elasticity,

which experts say is the quality that tends to keep a condom intact during intercourse.

□ Several condoms promoted as "thin" are not especially so, according to our measurements. And the condoms that really are thinnest, although they passed the basic inflation test, tended to break more easily than did the other condoms we tested. They may not provide as much protection as their thicker counterparts.

## A protective barrier

It may not be obvious from the packaging, but all condoms are pretty much the same. They're nearly all made of latex, in the same basic shape, according to industry standards for size and thickness.

Latex condoms are produced by dipping a cylindrical form in liquid latex and heating it. Machines shape and trim the condom's ring; then the new condoms are washed and aged for a number of days, a "curing" that lets the rubber complete the chemical reactions that strengthen the latex. The final steps: rolling and wrapping individual condoms. The basic process hasn't changed much in 50 years.

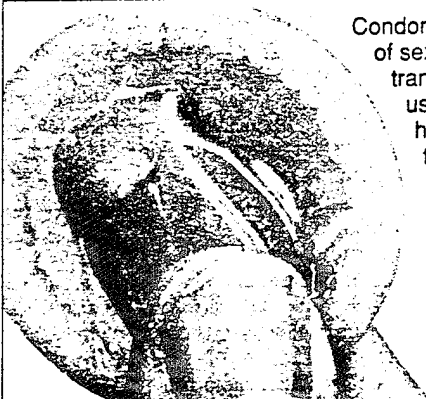
The industry standards say a condom's width should be no greater than 54 millimeters—about 2½ inches—to prevent slippage; "snugger" condoms are about 10 percent narrower. The minimum length is 160 millimeters, roughly 6½ inches, but some products are up to 2 inches longer.

## Condoms for contraception

As a contraceptive, condoms are cheap and easy to obtain, and usually cause no side effects. (A very small number of people are allergic to latex—see "Two Ways to Avoid Latex," page 323.)

They are not, however, perfect. The condom's reliability in preventing pregnancies depends on how it's measured. Researchers don't count the number of individual condoms that fail; instead they define contraceptive failure as the percentage of women who use a given method but nonetheless become pregnant over a year's time. For condoms, the typical rate is about 12 percent, somewhat worse than birth-control pills but better than the diaphragm (see graph on facing page). But researchers know that, as with other methods, the failure figures include many couples who don't use contraception every time.

## FOR PREVENTION OF DISEASE



Condoms are considered crucial for slowing the spread of sexually transmitted diseases, because the odds of transmission are cut nearly to zero if condoms are used consistently and correctly. If they're not used, here is the estimated chance that microbes will be transmitted from one infected partner to the other during a single act of intercourse.

Microbe for:	male-to-female	female-to-male
Gonorrhea	50 to 90 %	20 %
Genital herpes	0.2	0.05
AIDS	0.1 to 20	0.01 to 10

Source: K.M. Stone, *HIV, STDs, and Other Barriers. In Barrier Contraceptives, Current Status and Future Prospects, 1994.*

If couples used condoms consistently and correctly, researchers estimate, the condom's failure rate would plummet to 2 or 3 percent, or perhaps even less. One way some couples might further reduce the failure rate—to an estimated one-tenth of a percent, if used consistently—is to use condoms in combination with a vaginal spermicide.

## Stopping germs

As a means of preventing the transfer of disease causing microbes between sex partners, condoms have no equal. The condom shields the penis from cervical, vaginal, oral, or rectal secretions. At the same time, the partner is protected from potentially infectious semen and any lesions on the penis.

The need for such protection is apparently greater than many people realize: Every year, 12 million Americans—one-fourth of them teenagers—come down with sexually transmitted diseases. Chlamydia, the most common such disease but often unrecognized, can lead to tubal scarring that experts believe is a key factor in the quadrupling of ectopic pregnancies in the last 10 years. And AIDS is still increasing in the U.S., particularly among women. (Gay men still account for the largest number of AIDS cases; there's concern that condom use is falling among younger gay men.)

Chlamydia, gonorrhea, and AIDS—as well as other sexually transmitted diseases—are virtually 100 percent preventable with proper condom use. So well do latex condoms block germs that, since 1987, the U.S. Food and Drug Administration has allowed condom boxes to list all the diseases condoms help avert. More recently, the FDA told companies that the disease-prevention message was so crucial, they should also print it on the wrappers of individual condoms. Condom boxes warn that the product is intended for vaginal sex, but health officials say it's crucial to use condoms in anal and oral sex, too.

Preventing sexually transmitted disease is in some ways a more rigorous test of condoms than is preventing pregnancy. While conception is a concern only a few days a month, diseases can be caught all the time. Over the decades since the latex condom's introduction, epidemiologists have amassed considerable evidence that it does cut disease rates, but not quite to zero. A 1992 review in the American

Journal of Public Health, summing up the results of many varied studies, found that condoms on average cut the risk of infection in half. But the authors said the studies included many couples who failed to use condoms properly or consistently.

When couples are strongly motivated to use condoms every single time, the score greatly improves. Herbert Peterson, chief of the CDC's women's health and fertility branch, cited two recent "blockbuster" studies on condoms' use against HIV. Both focused on heterosexual couples, with one partner carrying HIV at the start of the study, who continued to have sex regularly for two years or more.

In the first study, Italian researchers followed more than 300 healthy women in stable, monogamous relationships with HIV-positive men, questioning the women closely about condom use and testing them periodically for HIV. Among women whose partners never or inconsistently used condoms, 12 percent eventually were infected with HIV. By contrast, fewer than 2 percent of the women whose partners always used condoms became infected.

The second report, from the European Study Group, showed even better results for some 250 uninfected men and women with HIV-positive partners. Among the half who used condoms inconsistently, 10 percent of the previously uninfected partners acquired HIV. When condoms were used all the time, however, HIV was never passed on to the healthy partner—even though the average couple had sex about 120 times over the course of the study.

"If everyone used condoms correctly and consistently, we could break the back of the AIDS epidemic," Peterson told us.

## When they fail

An estimated 2 to 5 percent of condoms tear during use. Most of those failures are thought to stem from misuse, not inherent product flaws. (And misuse is common: When the British Consumers' Association asked some 300 Englishmen to demonstrate putting a condom on a model penis, nearly one in five got it wrong—they tried to unroll the condom from the inside out.) Bruce Burlington, who heads the FDA's Center for Devices and Radiological Health, which is responsible for condoms, told a CU reporter that

the difference in quality between the best and worst condoms on the market is "tiny compared with the problems that users introduce."

When condoms do break despite being used correctly, it's probably caused by hidden weaknesses in the rubber. Both manufacturers and the Government take steps to catch flawed condoms before they can leave the factory.

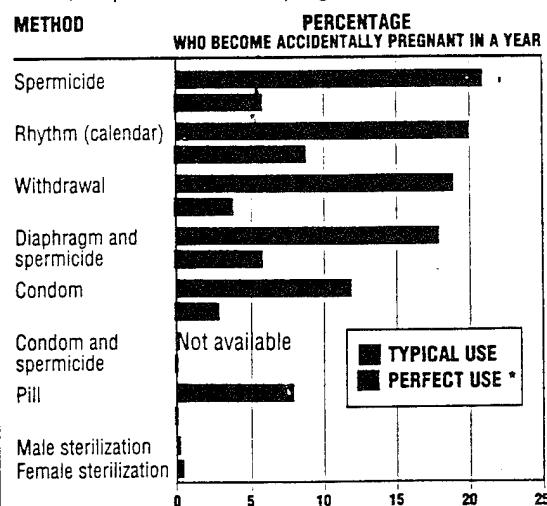
Manufacturers test each lot of condoms for leaks and for strength, according to voluntary guidelines set by the American Society for Testing and Materials, the major U.S. standards-setting organization. Those tests, however, which destroy the condoms being examined, can be used only to spot-check a batch of condoms, not to check individual condoms before packaging and sale.

Companies can test every condom for leaks, with a gentler but telling electrical procedure. In one variant of the test, each condom is placed on a charged metal form and swept over by a soft, conductive brush. Minute holes in the condoms trip circuitry that shunts many "leakers" aside. Sometimes this test finds thin spots as well.

The FDA, which regulates condoms as medical devices, sends in-

## FOR BIRTH CONTROL

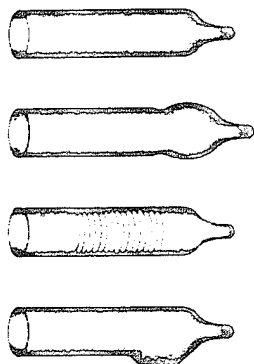
As a contraceptive, condoms are more effective than the diaphragm, less so than the Pill. Below are percentages of women relying on each method who nonetheless become pregnant over a year's time. If birth control is used perfectly—consistently and correctly—failures can be cut dramatically. If no birth control method is used, 85 percent become pregnant.



Source: "Contraceptive Technology," Irvington Press; and "Family Planning Perspectives" journal.

\* Estimated

**Shapes vary** The brands we tested included plain condoms (Ramses), contoured (Saxon Gold), textured (Trojans Ribbed), and an unusual pouch (Pleasure Plus).



spectors to factories unannounced. They review production records and examine stock at random, checking for cracked, moldy, dry, or sticky rubber. The inspectors also test the condoms—until now primarily with a water-leakage test. In this protocol, they pour 10 ounces of water into a condom, then press and roll it along blotter paper. Should leaks turn up in the equivalent of more than 4 per 1000 condoms in a run, the manufacturer must scrap the entire lot, perhaps tens of thousands of condoms.

In 1993, the latest year for which we could obtain data, the FDA rejected 2 of the 44 lots of domestic condoms it checked for leakage. The FDA tests every batch of imported condoms as well, though imports account for very few condoms used in this country.

Although the smallest hole the water test can find is 100 times bigger than the HIV virus, officials believe the test is sufficient. The laboratory and clinical studies of HIV persuade them that smaller

holes are rare or possibly even nonexistent. Such minute holes are a problem for "skin" condoms, however (see box on opposite page).

### How we tested condoms

When we last tested condoms, in 1989, none of the brands we checked failed the water test. This time, we concentrated on air-burst testing, which we think better predicts breakage in use. Condoms are locked onto an apparatus that slowly inflates them until they're bigger than a watermelon and finally burst with the bang of a gunshot. Meters record the volume of air and amount of pressure the condom withstand.

Unlike tests of tensile strength—done by stretching a band cut from the condom—air-burst testing stresses the entire condom. Last year, the FDA added the air-burst test to its inspectors' repertoire, and asked the companies to include it in their internal quality-control regimens. The testing guidelines are expected to be adopted shortly as the industry standard.

Published research has linked a condom's air-burst volume to its resistance to breakage during use. Scientists believe that a condom's "extensibility"—its stretchiness—is what helps keep it whole during intercourse. The air-burst test assesses that vital quality.

We tested about 120 individual condoms for each of the 37 styles we bought. To see as many lots as possible for each product, we generally combined samples from five

different lots, identifiable by date codes on boxes.

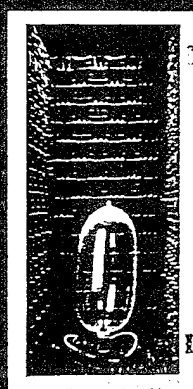
As the Ratings show, our tests were designed to answer two questions: whether a condom passes a minimal standard and, if so, how well it performs on a tougher test, a measure of a product's tendency to break in use. To make the first cut, our combined lots of each product had to pass the new Government air-burst requirement. That rule allows no more than 1½ percent of condoms in a lot to fall short of the required pressure and volume limits. Average-sized condoms, for instance, are supposed to inflate to at least about 16 liters (it varies with condom width) before breaking. Using statistical techniques, inspectors can sample a production run and project a failure rate for the entire lot.

Seven products we tested did not meet that minimal requirement. In each case, at least 4 out of 120 condoms broke too soon during inflation. Based on statistical projections, we believe that more than 1½ percent of condoms in at least some of those products' manufacturing lots would not have inflated to the required minimum volume of air. The products include six styles of *Trojans*—including, ironically, *Trojans Extra Strength*—and *LifeStyles Ultra Sensitive*. We downrated all seven in the Ratings.

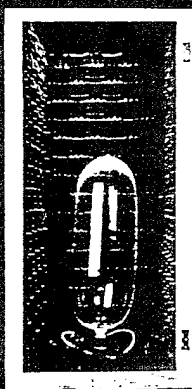
For the 30 products that passed that initial screening, we then ranked condoms by a "burst index"—the percentage of samples that withstood at least 25 liters of air. This volume is much greater than

## INFLATION TEST

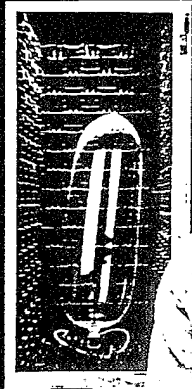
**In air-burst testing, condoms are inflated until they pop; a computer records the volume they withstand. Our minimum standards require average condoms to hold at least 16 liters of air—the same level being adopted by Government inspectors and as an industry standard. The Ratings' Burst Index ranks condoms by how well they handled 25 liters, a volume we consider crucial for predicting breakage in use. Some products inflated past 40 liters before they broke.**



**16  
LITERS**



**25  
LITERS**



**40  
LITERS**



the standards specify, but we consider it a crucial measure. In a key study in the journal *Contraception*—which relied on 260 couples who used 4600 condoms—breakage was more likely among products from manufacturing lots whose condoms typically could not hold 25 liters of air before rupturing.

Condoms with higher scores on this index should offer greater pro-

tection. Three products turned in perfect scores in our tests: *Excita Extra Ultra-Ribbed Spermicidally Lubricated*, *Ramses Extra Ribbed Spermicidally Lubricated*, and the U.S.-made version of *Sheik Elite Lubricated* (distinguished from the Japanese-made version by a label on the box). The other high-scoring condoms include a mix of *LifeStyles*, *Ramses*, *Sheik*, and *Trojans* brands with var-

ied lubricants, both straight and contoured.

## Recommendations

Latex condoms work well—both to prevent pregnancy and to avoid sexually transmitted diseases. Unless you know your partner is uninfected, the CDC recommends—for disease prevention—that you use condoms, start to finish, for all

## OTHER CONDOM OPTIONS

### TWO WAYS TO AVOID LATEX

If latex condoms irritate your skin, the culprit may be the lubricant, the spermicide, or the materials used in processing; try switching brands. If that doesn't work, you may be among the small percentage of people whose skin is sensitive to latex itself. You have two other choices in condoms, each with pluses and minuses.

#### 'Skin' condoms

Made from a natural pouch in lambs' intestines, these condoms cost several times as much as latex ones. The membrane is especially strong and may enhance sensitivity. The downside: They have small holes.

The microscopic pores can be up to 1.5 microns across. Since sperm cells are twice as wide as that, skin condoms still make an effective contraceptive. But viruses and some bacteria are far smaller than these pores (see diagram). Lab work has shown that HIV and the herpes and hepatitis-B viruses can pass through skin condoms. So these condoms must bear a warning that they are not intended for disease prevention.

We examined *Fourex* and *Kling-Tite Naturalamb* brands. *Fourex* condoms come folded, not rolled, inside plastic

capsules (the condom is pulled on, like a glove). We found the capsules surprisingly hard to open. *Kling-Tite* may be easier to don because it's rolled, like a latex condom. Skin condoms might slip off some men during intercourse because both *Fourex* and *Kling-Tite* are significantly wider than the latex condoms we tested: 78 and 68 millimeters, respectively (latex condoms average 52 millimeters). The *Fourex* has a rubber band rolled onto the base of the condom to prevent slippage. The *Kling-Tite's* elastic band is sewn on more securely.

#### Polyurethane condoms

Last year, on the basis of limited testing, the FDA gave Schmid Laboratories approval to sell its new *Avanti* brand, a clear condom made of polyurethane. The agency justified approving the product because it felt a pressing public-health need to offer latex-sensitive people an alternative that could prevent disease as well as pregnancy. The *Avanti* condoms first appeared in Western states and should be available elsewhere by summer. But it's unclear just how much protection they offer. A label on the foil packet declares it "effective" against pregnancy and sexually transmitted diseases, while the label on the box warns that "the risks of pregnancy and STDs . . . are not known for this condom." The FDA says it has noted the discrepancy; the packet label will be changed to match the box.

The manufacturer says it has demonstrated to the FDA that *Avanti* does block viruses and neither slips nor breaks

more often than latex. Studies of its contraceptive value are under way.

We bought *Avanti* and *Avanti Super Thin*, which cost us \$1.75 each, more than the most expensive latex condoms. Both products are in fact the same condom; the *Super Thins* come with more lubricant.

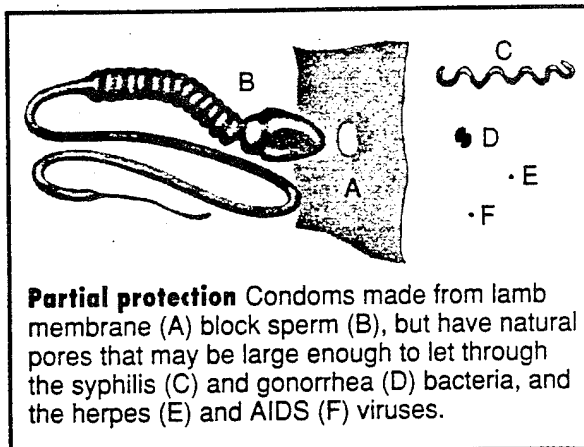
In the lab, we found the condoms thinner than any conventional condoms tested—roughly 0.04 millimeters. They are also among the shortest of condoms but wider than even larger-size latex brands (60 millimeters versus 55 or 56). That's probably because polyurethane doesn't stretch as much as latex. Despite the company's statements to the contrary, we suspect some men might have slippage problems. When we placed the *Avanti* on a model of an average-sized penis, we found we could pull the condom off quite easily.

Since *Avanti* isn't latex, the label claims that any lubricant may be used safely. We cannot comment on the *Avanti's* strength. Because synthetic condoms are so new, researchers don't know how to compare their performance in standard tests against that of latex condoms.



#### Mixed messages

The box and packets of this new polyurethane condom bear conflicting messages about users' risks of disease or pregnancy. The correct answer, the FDA says: The risks are unknown.



**Partial protection** Condoms made from lamb membrane (A) block sperm (B), but have natural pores that may be large enough to let through the syphilis (C) and gonorrhea (D) bacteria, and the herpes (E) and AIDS (F) viruses.

**Highly ranked condoms**  
Products that did especially well in our air-burst tests were Excita Extra Ultra Ribbed, the domestic version of Sheik Elite, and Ramses Extra Ribbed. We judged Touch from Ptex, which costs less than 35 cents each, A Best Buy.



sex—vaginal, anal, and oral.

Here are important factors to consider when selecting a condom:

**Strength.** Among the 30 products that passed our initial screening, those with a higher Burst Index should minimize the possibility of breakage during sex. Our findings don't match the claims on several packages, however. Five condoms we tested claim to be strong (or stronger than some other brand), but only one of those products—*Ramses Extra Ribbed Spermicidally Lubricated*—earned a top score on our Burst Index.

**Sensitivity.** When researchers asked a national sample of men in their 20s and 30s about condoms, the biggest gripe concerned sensitivity: Three out of four complained that condoms reduce sensation.

Some brands claim to enhance sensitivity, but it's not clear how they do. Some makers say a snug condom helps, but others say it's a looser fit (*Pleasure Plus* has a floppy

pouch near the head, for instance). As a group, condoms promising sensitivity aren't especially thin, by our measurements.

What's more, even if a thin condom does heighten sensitivity, thin is not necessarily desirable. The thinnest products—*Beyond Seven*, a Japanese import; and *Sheik Super Thin* and *Ramses Ultra Thin*, both American—had some of the lowest burst scores; they passed our minimum standards, but may not always hold up as well as higher-ranked condoms. When inflated, one-fourth to one-third of those thinner condoms did not reach the crucial 25-liter mark before bursting.

If sensitivity is an issue for you, be aware that this is a poorly defined term. If you want to try some "sensitive" products, it's safest to start with the higher-scoring condoms that make this claim—such as the top-rated *Excita Extra Ultra Ribbed*—before trying thinner ones.

**Size.** Size does matter. If a con-

dom is too tight, it can be both uncomfortable and more likely to break; too loose, and it is more likely to slip off. We measured the condoms: Width varied by 12 percent, product to product; length, by almost 20 percent. (The two types we tested that claim to be larger than average—*Trojan-Enz Large* and *Trojan Magnum*—were in fact longer and wider.) The Ratings give the details.

**Lubricant.** Many condoms come coated with various preparations that feel like oil, glycerine, or surgical jelly. Using a lubricated condom is largely a matter of preference. If couples wish to add their own lubricant, they should be certain not to use petroleum- or mineral-oil-based products, which rapidly weaken latex. (See "Using Condoms Wisely," at left.)

**Spermicide.** Many condoms' lubricants include a small amount of nonoxynol-9, a spermicide that promises extra protection. It's a promise without much proof behind it. In the test tube, the chemical does kill sperm and inactivate a range of microbes, including HIV. But no one knows if it works as well in real use and if there's enough of it to make a difference if the condom breaks. (The CDC says it's optional, that the latex barrier alone should offer sufficient protection.)

**Age.** As condoms age, the rubber in them may weaken, so it's a good idea to avoid packages that are more than a few years old. (We found no sign of aging among the condoms we tested, which were all less than three years old.) Unfortunately, different brands date products differently. Bear this in mind when you're checking the label: Products containing spermicide are given a shelf life of roughly two or three years (to assure that the spermicide still works), while other condoms are allowed as many as five years on the shelf. ■

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## USING CONDOMS WISELY

Most of the products we tested provide adequate instructions, often including pictures. But some print the information on the inside surface of the box, which must be torn apart before the instructions can be read. That's unfortunate—good instructions are key for people unaccustomed to using condoms.

Here are the most important points to remember:

- Open an individual packet only when ready to use the condom—and open it gently, to avoid tearing the contents. If the rubber feels brittle or sticky or looks discolored, discard the condom—it's spoiled.

- Don the condom when the penis is erect but before sexual contact. Place the tip of the rolled-up condom over the penis. If there is a reservoir tip, first squeeze out the air. If there is no tip, leave a half-inch space at the end for semen, and squeeze the air out.

- Unroll the condom down the entire length of the penis (uncircumcised men should first pull back the foreskin).

- Right after ejaculation, grasp the condom firmly at the ring and withdraw before losing the erection, to prevent spillage.

- Use a new condom for each act of intercourse—never reuse condoms.

- Store condoms in a cool, dry place. Heat, light, and air pollution can all hasten deterioration.

- If you want additional lubrication, use only water-based lubricants, such as surgical jelly. Petroleum jelly and mineral-oil products (baby oil, cold cream, many hand lotions) all rapidly weaken latex. Even some lotions that easily wash off with water may contain oils; check the label.

- If a condom does fail, both partners should wash their genitals with soap and water. Urinating may also help to avoid infections. If the breakage is discovered after ejaculation, having a separate spermicide handy to apply quickly may help. Or a doctor can prescribe an intense dose of birth-control pills, which will block most pregnancies if used within 72 hours of intercourse.

# RATINGS Latex condoms

Listed in order of air-burst performance

Product	Cost PER CONDOM	Burst index	Lubricant feel	Spermicide	Size (LENGTH x WIDTH)	Thickness	Comments
		0 20 40 60 80 100					
<b>Excita</b> Extra Ultra-Ribbed, spermicide	\$1.00		glycerine	8%	193 x 53 mm	0.07 mm	Textured. Product renamed Sheik Excita Extra Ribbed.
<b>Ramses</b> Extra Ribbed, spermicide	0.99		glycerine	5	187 x 52	0.07	Textured.
<b>Sheik</b> Elite ①	0.53		oily	—	187 x 52	0.07	Renamed Sheik Classic.
<b>LifeStyles</b> Vibra-Ribbed	0.44		glycerine	—	188 x 54	0.08	Wider than most. Textured.
<b>Ramses</b> Extra, spermicide	0.75		glycerine	15	200 x 51	0.07	Spermicide now 5%.
<b>Ramses</b> Sensitive	0.83		oily	—	192 x 52	0.07	—
<b>Sheik</b> Elite Ribbed, spermicide	0.68		oily	8	190 x 51	0.07	Textured. Renamed Sheik Classic.
<b>Sheik</b> Elite, spermicide	0.59		oily	8	190 x 51	0.07	Renamed Sheik Classic.
<b>Trojan-Enz</b> Large	0.75		jelly	—	214 x 56	0.07	Wider, longer than most.
<b>Trojan-Enz</b> Nonlubricated	0.47		—	—	191 x 53	0.07	—
<b>LifeStyles</b>	0.46		glycerine	—	186 x 54	0.07	Wider than most.
<b>Touch</b> from Protex, <b>A BEST BUY</b>	0.31 ②		oily	—	193 x 52	0.07	—
<b>Trojan-Enz</b> , spermicide	0.64		jelly	5	202 x 51	0.07	Heavier lubrication than most.
<b>Saxon</b> Gold Ultra Lube	0.43		jelly	—	191 x 51	0.08	Contoured.
<b>Trojan</b> Magnum	0.69		oily	—	205 x 55	0.07	Wider, longer than most. Heavier lubrication than most.
<b>Trojan</b> Very Sensitive	0.62		oily	—	206 x 50	0.07	Longer but narrower than most.
<b>LifeStyles</b> , spermicide	0.45		glycerine	7	189 x 54	0.06	Wider than most. Heavier lubrication than most.
<b>Trojan</b> Ribbed	0.64		oily	—	199 x 53	0.07	Textured.
<b>Rough Rider</b> Studded	1.04 ③		glycerine	—	186 x 53	0.10	Textured. Heavier lubrication than most.
<b>LifeStyles</b> Extra Strength, spermicide	0.65		oily	7	191 x 53	0.09	—
<b>Gold Circle</b> Coin Nonlubricated	0.60 ④		—	—	184 x 52	0.09	Shorter than most.
<b>Sheik</b> Elite ③	0.53		oily	—	188 x 51	0.06	Discontinued.
<b>Trojan</b> Naturalube Ribbed	0.66		jelly	—	205 x 53	0.07	Longer than most. Textured.
<b>Class Act</b> Ultra Thin & Sensitive	0.33 ②		oily	—	193 x 53	0.06	Wider than most.
<b>Kimono</b>	0.39		glycerine	—	193 x 52	0.07	Contoured. Lighter lubrication.
<b>Pleasure Plus</b>	0.98		glycerine	—	197 x 51	0.09	Textured, with floppy pouch.
<b>Beyond Seven</b>	0.50		oily	—	194 x 50	0.05	Narrower than most. Lighter lubrication than most.
<b>Gold Circle</b> Rainbow Coin Nonlubricated	0.67 ④		—	—	180 x 51	0.08	Various colors, contoured.
<b>Sheik</b> Super Thin	0.62		glycerine	—	193 x 51	0.05	—
<b>Ramses</b> Ultra Thin	0.88		glycerine	—	190 x 51	0.05	—
The following products, listed alphabetically, had an overall burst volume defect rate that exceeded 1.5%.							
<b>LifeStyles</b> Ultra Sensitive	0.46		glycerine	—	187 x 53	0.06	—
<b>Trojan</b> Extra Strength	0.78		oily	—	198 x 53	0.07	—
<b>Trojan</b> Mentor	*1.08 ④		glycerine	—	181 x 52	0.07	Contoured. Has applicator and adhesive band.
<b>Trojan</b> Plus	0.66		oily	—	196 x 52	0.07	Contoured.
<b>Trojan</b> Very Thin	0.64		oily	—	195 x 53	0.06	Lighter lubrication than most.
<b>Trojan-Enz</b>	0.58		jelly	—	201 x 54	0.07	Wider than most.
<b>Trojans</b> Nonlubricated	0.49		—	—	200 x 53	0.06	No reservoir tip.

① Higher-rated product made in U.S.; lower-rated, in Japan (box flaps are marked).

② Purchased in boxes of 13.

③ Purchased in boxes of three.

④ Purchased in boxes of six.

## Notes on the table

**Cost** is the estimated average, based on a national survey. An \* indicates the price we paid. Except where noted, we purchased boxes of 12.

**Burst index** is the percentage of condoms that inflated to at least 25 liters in air-burst testing. Products with higher scores should offer greater assurance against breakage in use.

**Lubricant feel** indicates which substances feel like oil, glycerine, or surgical jelly.

**Spermicide** in the lubricant may offer some extra safety against disease and pregnancy if a condom breaks; the extent of this protection is unknown. Figure given is the concentration of nonoxynol-9.

**Size** was measured on unrolled, flattened condoms and are averages of several samples. Proper fit

affects comfort and may help avoid breakage or slippage.

**Thickness** is the average of three measurements along the length of the condom. The typical condom we tested is about 0.07 millimeters thick.

**Comments** identify textured condoms—which have raised bumps or rings—and contoured condoms—which generally flare out near the head of the condom.

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Friday, August 11, 1995

# DECISION MAKING IN ALTITUDE ILLNESS

*Peter Hackett, MD*

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*Case studies will be distributed during the workshop.*

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Friday, August 11, 1995

**ADVANCED RESCUE  
TECHNIQUES**

*Mountain Rescue Aspen*



## **ADVANCED RESCUE TECHNIQUES**

### **HIGHLINE RESCUE SYSTEM**

#### **Mountain Rescue-Aspen**

During this workshop Mountain Rescue Aspen (MRA) will conduct a field demonstration of a HIGHLINE rescue system. This system is used to reach and recover a victim who is in rough terrain or in an inaccessible situation.

•During this demonstration, participants will be introduced to MRA operations and applicability for the HIGHLINE system.

•Participants will observe and gain an understanding of:

- safety implications in a technical rescue environment
- communications procedures
- implementation of the Incident Command System (ICS) at the rescue team level
- technical elements of a HIGHLINE system
  - anchors
  - brakes
  - knots and prusiks
  - mechanical advantage (pulley)
- rigging and handling of the litter

#### **Personal gear recommended:**

- hiking boots
- rain gear
- water

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Friday, August 11, 1995

# HEAT EMERGENCIES

*Eric A. Weiss, MD*

## CASE PRESENTATION

George is a 49-year-old executive who has driven from Atlanta, Georgia along with three of his friends to raft the Chattooga River in Northern Georgia. They had heard that this was the river where the movie "Deliverance" had been filmed. George had played lineman for the University of Georgia and has maintained a hard-driving attitude in his business. He recently had an EKG stress test which was suggestive of coronary artery disease and he has been advised to see a cardiologist. His past medical history is significant for hypertension. Socially, his wife is filing for divorce because he drinks too much, works most of the time, and prefers to spend whatever free time he has "with the guys." He takes Inderal for his hypertension, Elavil for depression, and Actifed for hay fever. George and his friends arrive at the rafting company at 9 a.m., having already consumed three six-packs of their favorite beverage, "Bud", and are eager to "ride the river." The temperature is 82 degrees Fahrenheit and the relative humidity is 90%.

## QUESTIONS TO PONDER

1. What are the environmental factors which predispose someone to heat illness?
2. How does the body compensate for these factors?
3. Can the relative risk of developing heat illness be objectively measured?
4. Does George have any pre-existing medical problems that increase his risk for developing heat illness?
5. Do any of George's medications predispose him to heat stroke?
6. Why is George's raft guide about to have a bad day?

#### MECHANISMS FOR ACCUMULATING HEAT

1. Basal metabolism alone can create a heat load of 65 to 85 KCAL/hr, which would raise the body temperature 1.1 degrees Centigrade/hr if mechanisms for dissipating heat did not exist.
2. Moderate work could increase this temperature rise by 500% (300-600 KCAL/hr).
3. An individual in bright sun may gain 150 KCAL/hr.
4. Prolonged exposure in hot tubs, saunas, and steam rooms can raise body temperature.
5. Elevated body temperature in turn imposes its own intrinsic additional heat load since cellular metabolism will increase by 13% for every 1-degree Centigrade rise in body temperature.
6. Studies done in runners have shown that dehydration alone is capable of elevating body temperatures. This is probably due to an increased activity of the cellular sodium pump, which accounts for 20-45% of the basal metabolic rate (BMR).
7. When the air temperature is greater than the body temperature, radiant heat gain is possible.

#### MECHANISMS FOR DISSIPATING HEAT

1. Radiation, the transferring of heat from the body to a cooler environment, accounts for 65% of cooling as long as the air temperature is lower than the body temperature.
2. Normally, 30% of cooling results from evaporation of sweat. For each 1.7 ml of sweat evaporated, the body loses 1 KCAL of heat. When the ambient temperature approaches 95 degrees Fahrenheit, evaporation prevails as the only mechanism that the body has to dissipate heat. If the humidity level should exceed 75%, evaporative heat loss potential will decrease. Sweat that drips from the skin only exacerbates dehydration without providing any cooling benefit.

\*\*\*\*\*  
\* TAKE HOME MESSAGE \*  
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- The combination of high temperature and high humidity blocks the two main mechanisms that the body has to dissipate heat. The conditions are right for "heat stroke."

#### PHYSIOLOGICAL RESPONSES TO HEAT

1. Cutaneous blood vessels dilate to increase the surface cooling area.
2. To maintain blood pressure, in the face of this greatly decreased peripheral vascular resistance, cardiac output may double or quadruple, placing a strenuous load on the heart.
3. There is a compensatory vasoconstriction in the splanchnic vessels.
4. Sweat volume will increase.
5. Acclimatization to heat.
  - a. In contrast to hypothermia, physiologic acclimatization to heat is possible. It usually takes one 8-11 days to reach maximum benefit and requires some degree of exercise (at least 1 1/2 to 2 hours) each day.
  - b. The mechanisms, although poorly understood, seem to be mediated through activation of the Renin-Angiotensin system with increased production of aldosterone. This results in sodium conservation in both urine and sweat with concomitant losses of potassium.
  - c. Sweating is initiated at lower core temperatures and the amount of sweating may more than double.
  - d. Three cardiovascular adaptations which result in enhanced delivery of heated blood from the core to the surface have been shown to occur: (1) An increased cardiac output; (2) A decreased peak heart rate; and, (3) An increased stroke volume.
  - e. There occurs a marked increase in the density of mitochondria per unit muscle mass. This allows increased potential for oxygen utilization.

INDIVIDUAL CHARACTERISTICS WHICH  
PREDISPOSE SOMEONE TO HEAT

1. The elderly are less able to increase cardiac output for heat dissipation and are often dehydrated. Intrinsic diseases of the heart such as CAD, CHF, or previous MI would limit the ability to compensate for peripheral vasodilatation.
2. Neonates lack thermoregulatory and sweating capabilities.
3. Obese individuals have more insulation and less surface area-to-volume ratio with which to dissipate heat.
4. Hyperthyroidism can markedly increase metabolic rate with a rise in endogenous heat production.
5. Dermatologic disorders, as well as burns affecting large surface areas, may limit heat dissipation by sweating.
6. Various medications and drugs may predispose one to environmental heat illness.
  - a. Beta-blockers will inhibit compensatory increases in cardiac output.
  - b. Amphetamines, PCP, cocaine, and other stimulants can increase muscular activity with a resultant increased endogenous heat load. Amphetamines and LSD also act directly on the hypothalamus to produce elevated temperatures.
  - c. Anticholinergics such as phenothiazines, lithium, tricyclic antidepressants, antihistamines, and antispasmodics reduce sweating and can disrupt hypothalamic function.
  - d. Diuretics may produce dehydration.

HEAT EXHAUSTION VERSUS HEAT STROKE  
(See Table I)

Heat exhaustion and heat stroke are often discussed separately, implying that they are two different and distinct pathophysiologic entities. This is misleading because, with few exceptions, they define a continuum of one disease process. Heat exhaustion

often presents with flu-like symptoms, including malaise, headache, anorexia, nausea, vomiting, and muscle cramps. Core temperatures are usually less than 41 degrees Centigrade (106 degrees Fahrenheit) and often are normal. Dehydration is almost always manifest. Clinical signs may include orthostatic hypotension, tachycardia, diaphoresis, and moderate pyrexia. Dehydration, hypokalemia, and relative hypoglycemia have all been implicated as precipitating factors in the development of heat stroke. It represents late stages of heat exhaustion as compensatory mechanisms for dissipating heat are failing. Decreased sweating due to dehydration and high-output cardiac failure contribute to a decompensating system for heat dissipation. Core temperatures may rise rapidly, producing cellular damage. A key point in differentiating heat exhaustion from heat stroke is that CNS function remains essentially intact in heat exhaustion. CNS dysfunction, such as delirium, ataxia, seizures and coma, would suggest heat stroke and mandate aggressive cooling measures. The exact temperatures at which cellular damage starts to occur is not clear, but oxidative phosphorylation becomes uncoupled at temperatures above 42 degrees Centigrade (107.6 degrees Fahrenheit). The resultant damage is both a function of the high temperature as well as the exposure time. Patients with higher temperatures for shorter periods may do better than those individuals who maintain more moderate temperatures for longer periods. Dry, hot skin is not mandatory to make the diagnosis of heat stroke. In one study of military recruits, 50% of the patients with heat stroke maintained their ability to sweat. Anhidrosis may be a late manifestation as a result of profound dehydration and necrotic plugging of sweat gland ductules. Patients with heat stroke almost always manifest signs of tachypnea, hypotension and sinus tachycardia. The cerebellum is most sensitive to heat and ataxia may be an early clue.

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 \* TAKE HOME MESSAGE \*  
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- Heat exhaustion and heat stroke are probably a continuum of heat disorders rather than distinct pathophysiologic entities. In the setting of heat illness, patients with CNS dysfunction should be treated for heat stroke.
- Sweating may still be present in heat stroke.

### COMPLICATIONS OF HEAT STROKE

1. Decreased renal perfusion can lead to acute tubular necrosis and renal failure.
2. Damage to muscle and rhabdomyolysis can produce myoglobinuria and exacerbate the nephropathy.
3. Hypoglycemia and hypocalcemia may occur.
4. Although hyperkalemia may be seen initially, total body potassium is usually decreased.
5. Markedly elevated liver enzymes are often seen, suggesting hepatocellular injury. SGOT, SGPT, and LDH values may be in the tens of thousands after 24 hours. Elevations to several thousand are often found even in some patients with heat exhaustion.
6. Bleeding, secondary to a consumptive coagulopathy, may occur. The precipitating factor is thermal damage to vessel endothelial cells with exposure Type III basement membrane collagen. A syndrome of DIC may occur at 1-3 days after onset of heat stroke.
7. The only organ not reported to be directly damaged in patients suffering from heat stroke is the pancreas.

### TREATMENT OF HEAT EXHAUSTION

1. Fluids, rest in a cool environment, glucose and conservative measures of cooling are essential treatment modalities. Urine should be monitored for rhabdomyolysis and a thorough neurological exam should be performed.

### TREATMENT OF HEAT STROKE

#### Pre-Hospital Care:

1. Begin cooling immediately at the scene. Remove clothing, spray any available liquid on the patient and fan to promote evaporative cooling. If nothing else is available, even urine can be used as a liquid medium. The fluid does not need to be cold to produce evaporative cooling.



2. Ice bags, chemical ice packs, or cold compresses should be placed in areas where large blood vessels come near the surface such as the neck, axilla, groin, and scalp. Studies using this technique have documented cooling rates of .1 degree Centigrade/minute (5 times that of controls). This technique avoids generalized cutaneous vasoconstriction and shivering.
3. Nothing should be given orally.
4. Aspirin and Tylenol are not effective, and aspirin is contraindicated because of its effect on platelets and clotting. The hypothalamic set-point is not elevated as it is in fever.
5. Patients should be transported as quickly as possible to a medical facility.

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 \* TAKE HOME MESSAGE \*  
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- Heat stroke should be considered a life threatening emergency. Several studies have shown mortality rates from 30 to 80%.

Emergency Room Care: The optimum method for cooling is controversial. Some large centers still use ice baths while others rely more on evaporative techniques. The different methods, along with experimental data on cooling rates, have been listed in Table II.

If the emergency facility is air-conditioned or in a non-humid environment, I prefer the evaporative techniques for cooling. The patient is fully undressed and sprayed with warm water to keep the skin temperature at approximately 32 degrees Centigrade. Fans are used to maximize evaporation. Ice packs can be simultaneously placed along the neck, axilla, and groin. This technique is safe and effective, and requires a minimum of preparation. It is also more practical for managing monitors, I.V.'s, endotracheal tubes and complications that might occur. In addition, it minimizes avoidance behavior and shivering. Most patients can be cooled to temperatures of 101 to 102 degrees Fahrenheit in under 40 minutes using either the ice bath or evaporative techniques. Hyperthermia may recur due to thermoregulatory instability, requiring additional cooling at a later time. Cooling should be discontinued when the temperature falls below 102 degrees Fahrenheit in order to prevent hypothermia from occurring.

Administration of I.V. fluids, consisting of D51/2 normal saline or lactated Ringer's solution, should be guided by urine output, central venous or wedge pressures, and blood pressure. Initial laboratory work should include a blood gas, CBC, electrolytes, BUN, creatinine, liver enzymes, CPK, calcium, platelet count, PT, PTT, and FDP.

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\* TAKE HOME MESSAGE \*  
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- Heat stroke victims should be cooled as rapidly as possible. The more rapid the cooling, the lower the mortality.

TABLE I

	<u>HEAT EXHAUSTION</u>	<u>HEAT STROKE</u>
SYMPTOMS	Flu-like symptoms (Headache, vomiting, muscle cramps, anorexia)	Same
*****		
SWEATING	PRESENT	MAY BE <u>PRESENT</u> OR ABSENT
*****		
CNS SIGNS	CNS function <u>un</u> impaired	CNS Dysfunction:
		1. Bizarre behavior
		2. Confusion, delirium
		3. Ataxia
		4. Seizure
		5. Coma
*****		
TEMPERATURE	Usually less than 41 degrees Centigrade (106 degrees Fahrenheit), often normal	Usually 41 degrees Centigrade or greater
*****		

TABLE II  
EXPERIMENTAL DATA ON COOLING

Method	Cooling Rate	Advantages	Disadvantages
PERITONEAL LAVAGE (Dialysate at 6-10° C)	0.56° C/Min	FAST!	1. Time consuming to set up. 2. Inherent complications
EVAPORATIVE (15° H <sub>2</sub> O spray .4 M/Sec Fan) 45° C Air	0.31° C/Min	1. Less shivering 2. Less vasoconstriction 3. Easier to monitor	1. Requires non-humid environment.
ICE WATER BATH	0.1-0.25° C/Min	1. Effective in humid environment.	1. Tub not available 2. Management difficult 3. Shivering 4. Vasoconstriction
ICED GASTRIC LAVAGE (Iced H <sub>2</sub> O at 200 ml/Min)	0.2° C/Min	1. Easy and rapid	1. Aspiration
ICE PACKS TO (Neck, Axilla, Groin)	.1° C/Min	1. Easy and rapid	-----
COLD INHALED AIR BY IPPB	0.02° C/Min		

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Friday, August 11, 1995

# ACCIDENT PREVENTION IN THE WILDERNESS

*NOLS*

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## **Provisions for Wilderness Treks: Safety Considerations**

by Tod Schimelpfenig, Risk Management Director  
The National Outdoor Leadership School

### **Summary:**

This lecture will present an overview of the risk management of the National Outdoor Leadership School, and relevant information about wilderness risk management incidents from other sources. We will discuss objective and subjective factors in wilderness accidents and end with some thoughts on risk management for wilderness expeditions.

### **Objectives:**

- Share the NOLS risk management history.
- Describe objective and subjective factors in risk management incidents in wilderness programs.
- Increase the participants awareness of strategies and specific techniques to manage wilderness programming risks.

### **Outline:**

Health and Risk Management Issues in Wilderness Adventures

- Wilderness Injuries and Illness: the NOLS Experience
  - Common injury and illness types and rates
  - Evacuation and serious injury rates

Risk Management: Ideas for the Field

- Objective Hazards
- Subjective Hazards: Accidents are human oriented
- Summary: Prevention Strategies

### **Most Frequent Medical Problems - NOLS**

Injury

sprains and strains  
soft tissue injury

Illness

flu and gastrointestinal symptoms

### **Most Frequent Medical Problems - COBS**

sprains  
gastrointestinal problems  
soft tissue injury  
exacerbation of a pre-existing condition

Paton, B.C. Health, safety and risk in Outward Bound. Journal of Wilderness Medicine. Vol3, #2, May 1992.

## **PRINCIPLE CAUSES OF ACCIDENTS IN OUTDOOR PURSUITS**

A Matrix Developed And Revised By Dan Meyer And Jed Williamson 1979-94

### Unsafe Conditions

- Swift Water
- Loose/Falling Rock/Snow Objects
- Animals/Plants
- Improper Clothing/Equipment
- Unexpected Weather
- Inadequate Area Security

### Unsafe Acts

- Poor Position
- Unauthorized/Improper Procedure
- Inadequate Food/Water
- Unsafe Speed (Fast Or Slow)
- Inadequate Instruction/Supervision

### Judgment Errors Due To

- Desire To Please Others
- Sticking To A Schedule
- Mis-Perception
- New/Unexpected Situation
- Fatigue
- Distraction

## **Accidents in North American Mountaineering.**

### **Top three immediate causes of mountaineering accidents:**

- fall on rock
- fall on snow
- falling rock.

A close fourth is exceeding abilities.

### **Top three contributing causes:**

- climbing unroped
- exceeding abilities
- inadequate equipment.

from Jed Williamson. Accidents in North American Mountaineering.

## **The International Safety Network**

### **Top three injuries:**

- athletic
- fracture/dislocation
- soft tissue

### **Top three causes:**

- falls
- strenuous exertion
- hit by object

Most common accident times late morning and late afternoon

from Alan Hale. International Safety Network 1989

## **The American Canoe Association says:**

### **Five recurring themes in water accidents:**

- not wearing PFD's
- cold water or cold weather
- inexperience
- alcohol
- victims are often non-swimmers

### **American Caving Accidents**

Three main causes of accidents:

caver fall  
equipment failure  
rockfall.

from: NSS News December 1990. American Caving Accidents 1989

### **Risk Management: Ideas For The Field**

Risks can be separated into two categories, objective and subjective, measurable and human. Hygiene and athletic injury are important health issues but let's not forget what can kill us out there: falling rock, moving water, falls, animals, weather and poor decisions.

Subjective Hazards: Acts of Man

Wilderness educators conveniently group hazards into objective and subjective. The former, while not necessarily predictable, are visible and understandable. We can see and understand rockfall, avalanches, moving water, cold water, deep water, weather, animals and flash floods. Subjective hazards are harder to get our hands around. They express our human frailty, our state of mind. Phil Powers, NOLS Chief Mountaineering Instructor, comments that we carry subjective hazards with us into the wilderness as unseen baggage, like that smelly lost sock that lurks in the bottom of our sleeping bag, and bring them to every decision making session.

### **Subjective Hazards**

- |                            |                                   |
|----------------------------|-----------------------------------|
| • overconfidence           | • lack of self-reliance           |
| • goals                    | • mis-information                 |
| • impatience               | • different perceptions of danger |
| • peer pressure            | • the immortal instructor         |
| • adding up small mistakes | • seeking comfort elsewhere       |
| • distractions             | • poor leadership                 |
| • fatigue                  | • poor expedition behavior        |
|                            | • poor expedition planning        |

### **Prevention Strategies**

be watchful  
be decisive  
be flexible  
be patient  
be humble  
don't be over cautious



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Friday, August 11, 1995

# **WILDERNESS DENTAL EMERGENCIES**

*David Swersky, DMD*

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Wilderness Dental Emergencies  
David S. Swersky, D.M.D.  
Aspen, Co

Dental emergencies such as oral infections, facial or dental trauma, and lost restorations, while rarely life threatening, can ruin a wilderness trip. Dental treatment in the field can only be considered palliative and the patient should seek dental care as soon as possible.

Following this course, participants will be able to:

1. Diagnose and relieve the effects of traumatic injury to the hard and soft tissues of the oral/facial area.
2. Differentiate between various types of infections in the oral cavity and provide symptomatic relief.
3. Add items to their emergency medical kit to include simple dental treatment in the wilderness.

I. Traumatic injury

- A. Osseous tissues
  1. Mandible
  2. Maxilla
- B. Teeth
  1. Simple fracture
  2. Fracture with pulp exposure
  3. Evulsion
- C. Soft tissue lacerations

II. Infections

- A. Pulp tissue
  1. Periapical abscess
  2. Inflamed pulp
- B. Periodontal abscess
- C. Pericoronitis of wisdom teeth

III. Other Problems

- A. Lost or broken filling
- B. Lost or loose crowns

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Saturday, August 12, 1995

# SAR DOGS

*Carla Tomaszczyk, EMT-D, et. al.*

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*Please refer to the same topic for Friday, August 11.*

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Saturday, August 12, 1995

# BASIC RESCUE SYSTEMS

*Steve Lyons, NREMT-P &  
Dickie Brown, NRWEMT-B-IV*

**WMS Workshop  
Mr. Lyons & Mr. Brown  
Wilderness Professional Training  
Crested Butte, Colorado**

**At the completion of this day, the health care provider will:**

1. Immobilize extremity fractures using bth conventional and improvised splints.
2. Identify concerns/hazards associated with the splinted patient.
3. Immobilize potentially spine injured patients using both conventional and improvised splints.
4. Be able to identify concerns/potential hazards associated with the lifting or moving of a patient during a back country SAR function.
5. Appropriately package patients for any given environment.
6. Identify concerns/potential hazards associated with the litter packaged patient.
7. Be able to identify the need for a complicated vs. simple raise or lower system for evacuation.

**Introduction**

Patient care: don't let potential information get in the way of treating your patient.  
Simplistic and clear thinking: VS trends, viz BP ↓, P ↑, R ↑, = vol shock w/ MOI  
4 Major ares of difference from most prehospital care texts:  
CPR Spine Wound CareDislocations

**Patient Assessment & Reporting**

Preparation / Scene Size-up  
Well-Being of Rescuers  
Initial Assessment - ABC's  
Stay & Play vs. Load & Go  
Focused Assessment - Medical/Trauma  
Detailed History & Physical  
Ongoing Assessment  
Communications  
Documentation

**Lifting, Moving, Extrication**

KED, OSS, Cervical collar: adjuncts to be used if available  
If you have enough people, hands-on stability will work if adjunct not available  
Major weight ares: Head, shoulder pelvis

**Litter Packaging**

Double vapor barrier system, ventable, monitor temperature  
No axial loading with spine injured patient  
Belay patient as well as litter

**Extremity & Spine splinting (conventional/improvised)**

Normal anatomical position is generally the most stable  
Check CSM before and after manipulation  
Traction and then align deformities

**Haul/Lower Systems - the Basics**

Counter Balance  
Tree Wrap  
Pig-Rig

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Saturday, August 12, 1995

# HIGH ANGLE RESCUE

*Mountain Rescue Aspen*

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## **HIGH ANGLE RESCUE**

### **Mountain Rescue Aspen**

During this workshop Mountain Rescue Aspen (MRA) will conduct a field demonstration of a HIGH ANGLE rescue system. This system is used to raise or lower an injured victim from a vertical environment.

- During this field demonstration, participants will be introduced to MRA operations and uses for the HIGH ANGLE system.
- Participants will observe and gain an understanding of:
  - safety implications in a technical rescue environment
  - communications procedures
  - implementation of the Incident Command System (ICS) at the rescue team level
  - technical elements of a HIGH ANGLE rescue system
    - anchors
    - brakes
    - mechanical advantage (pulley system)
    - knots and prusiks
  - the use of a Load-releasing hitch
  - pros and cons of different mechanical devices
  - rigging and handling of the litter

#### **Personal gear recommended:**

- hiking boots
- rain gear
- water

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Saturday, August 12, 1995

# DESERT SURVIVAL

*Mel Otten, MD*



## DESERT SURVIVAL

Edward J. Otten, MD

Director, Division of Toxicology

Professor of Emergency Medicine and Pediatrics

University of Cincinnati College of Medicine

Cincinnati, Ohio, USA

Following this presentation, participants will be able to identify the hazards associated with the desert environment and be familiar with the fundamentals of survival in general and desert survival in particular.

### I. Geography:

Deserts comprise about 15 per cent of the earth's land area and approximately 8% of the land area of the United States or 300,000 square miles is desert. Most of the American deserts are adjacent to National Parks and Forests and are frequently visited, i.e. Grand Canyon, Great Basin, Big Bend, Arches, Zion, Organ Pipe, Joshua Tree et al. An area that has less than 10 inches (25 cm) of rain, unevenly distributed throughout the year, is considered desert. Most deserts are found between 30 degrees South and 30 degrees North latitude, making them hot as well as dry, i.e. Sahara, Arabian, Australian, and Kalahari. There are several large areas of "cold" desert, i.e. the Gobi, Great Basin, and Patagonian that are found beyond 40 degrees North and South latitudes and have variable temperatures.

There are several climatic processes that produce desert areas. The

most important of these are the six cells of air currents that descend at the poles and near the Tropic of Cancer and Tropic of Capricorn. These air currents, driven by the sun and the rotation of the earth, create areas of relatively warm, dry climate. The second important process is the problem of rain shadows caused by mountain ranges along the western edge of the continents. These areas lie to leeward of the prevailing winds and moist oceanic air is unable to rise over the mountains before it cools and loses its moisture on the western slopes. The dry air then rises over the mountain and descends to the land drying it. The Andes shadow the Patagonian Desert, the Sierra Nevada and Cascades shadow the Great Basin and Mojave, the Great Dividing Range in Australia places most of that continent in a rain shadow. The dry land that is formed is unable to sustain a large amount of plant life. This lack of vegetation allows the sun's energy to directly heat the ground and rocks and concentrate in the soil and air directly above it. In a forested region the plants give off moisture via transpiration which along with the plants themselves absorbs most of the sun's energy before it can heat the soil. The large surface area of the vegetation also disperses the heat energy so that the temperature on a forest floor rarely rise above 100 F (39 C). The combination of solar radiation, high winds and hot temperatures causes an increase in the evaporation of any moisture that does reach the desert. The same factors that cause a high temperature during the day allow for a rapid loss of heat during the night. Temperatures may vary 40-45 degrees F in a single 24 hour period. It would seem that this climate would only allow for a sparse flora and fauna. This is not the case. Death Valley, where air temperatures have been recorded at 134 degrees F, has 600 species of plant, 30 species of mammal, 25 species of reptile, and 2 species of fish. The plants and animals that have evolved in this environment have developed ingenious methods for adapting to the aridity and extremes of temperature. Man, in order to survive in the desert, must adopt some of the same methods used

by the indigenous organisms.

## II. Preparation:

Obviously the more prepared someone is the more likely he or she will survive, all other things being equal. Things are never equal however and luck is probably the most important albeit the most uncontrollable factor. There are several controllable factors namely physical conditioning, clothing, survival kit, and survival skills that may prevent needless deaths in the desert.

A. Physical conditioning and acclimatization is probably just as important with desert travel as with mountaineering. The body's need for water cannot be lessened by these methods but the amount of electrolytes lost and the efficiency of the sweating apparatus can be optimized. Lower body strength may help to prevent an minor injury such as an ankle fracture that in the desert environment could be fatal if the injured person was unable to get help or water. Prior to a trip to the desert for the unacclimatized individual, I recommend a level of fitness at least equivalent to an aerobic workout to 80% of maximum heart rate for 30 minutes 4 times a week. Upon arriving in the desert area the individual should spend at least 3 days acclimatizing before starting out on any long hikes(>5miles). This will allow for the increased intake of water which may be 3-5 gallons per day, the adjustment to the lack of vegetation and increased solar radiation, and the large temperature variations. Most activity should take place between dawn and 10AM and between 3PM and dusk. Between 10AM and 3PM, the hottest time of the day, it is best to stay in the shade and sleep, read or handle domestic duties.

The most important conditioning is mental conditioning or "the will to survive". Throughout the survival literature this is constantly cited as the one thing that brought survivors through their ordeal. Unfortunately this cannot be taught. Fortunately, however, the potential is in all of us but

may only appear in extreme circumstances. Many medical personnel develop a sense of "aequanimitas" dealing with emergencies on a daily basis, jet pilots seem to have a similar trait. While the 'will to survive' is not exactly the same as these it may arise in unlikely individuals just like courage in a battle.

B. The clothing most suitable for the desert is similar to that worn in most wilderness areas only the type of material may be different. Polypropylene, wool, pile, and goretex are the choices of the mountaineer whose enemy is hypothermia. While hypothermia is a possibility on the desert, hyperthermia and dehydration are more likely. Ripstop cotton is ideal due to its evaporative ability and long sleeve shirts and trousers made from this material are excellent for desert conditions. A light color should be chosen to help reflect solar radiation. A pile jacket or wool sweater is needed at night in many desert areas. Most novices travelling in the desert remark on how cold it is at night and how ill prepared they were for it. A rule of thumb is "expose as little skin as possible". The skin must be protected from heat, ultraviolet rays, blowing sand, insects, and water loss. A hat is an absolute necessity and should be broad brimmed or a kepi to protect the neck and face. A cravat or large handkerchief can be used an emergency hat if the other is lost. It can also be used as a towel or soaked in water and placed between the head and the hat to act as a solar air conditioner. Sunscreen and chapstick should be used frequently to protect exposed skin. Sunglasses or goggles are needed to protect the eyes. Ultraviolet keratitis similar to snowblindness can occur especially at higher elevations. Corneal abrasions from blowing sand are quite common and preventable. Leather gloves protect the hands from hot objects as well as cactus spines and thorns. Footwear can be leather or manmade materials and should be ankle high or higher. Low cut shoes will allow sand to enter and do not give adequate ankle support. Jungle boots

with metal spike protection and running shoes may get extremely hot in the desert soil and are not a good choice for desert travel. Polypropylene or polypropylene and wool socks seem to decrease the amount of blistering and give adequate cushioning and insulation to the feet.

C. The survival kit should have the necessary equipment and supplies to help you survive yet be small enough to be carried with you wherever you hike in the desert. The principle component should be water or the means of acquiring it. Unfortunately water weighs 8 pounds to the gallon and this limits the amount that an individual can carry to about one days supply. A solar still should be carried along with water purifying tablets or iodine. The best way out of a survival situation is to be rescued, therefore signalling equipment is essential. Survival kit items should be selected that have multiple uses and they must be of high quality. Do not spare expense in purchasing equipment that your life may depend on. The following list is an example of a basic kit that may be carried in a relatively small pack.

Nylon canteen, 5 quart	Penlight
Canteen cup	Space blanket
Clear plastic sheet, 5'x5'	Sunscreen
Plastic tubing, 5'	Signal mirror
Iodine crystals	Whistle
Band-aids	Sunglasses
Swiss Army knife	Parachute cord, 50'
Waterproof matchbox	Compass
Insect repellent	Hard candy
Safety pins	Needle/thread

When weight is not a consideration, for example travelling in an automobile, the following items should be carried:

Plastic water container, 5 gallon/person	Toilet paper
Folding shovel	First aid kit

Nylon tarp

Gloves

Extra clothing

Food

CB radio

Necessity being the mother of invention many items from vehicles can be used in an emergency; the rear view mirror can be used to signal, the hubcaps to collect water, batteries to start fires, oil to produce smudge for signalling.

D. The best survival kit is of no use if the person carrying it does not have the skills to use it correctly. These skills must be learned and practiced regularly or they will be lost. Until you have actually built a solar still you cannot anticipate the problems encountered. An experienced person can produce a solar still in 15 minutes. An amateur will take 60 minutes and lose more sweat than the still will produce in a week. Direction finding, fire building, shelter construction and signalling are all necessary skills that must be learned before getting into a situation where your life may depend on them. It is too late to learn to swim after you have fallen out of the boat. Priorities in a survival situation is based on the "rule of threes", you can live 3 minutes without oxygen, 3 hours without warmth, 3 days without water and 3 months without food. Assuming that there are no immediate medical problems or environmental hazards, i.e. fractured pelvis, landslide, flash flood, etc., the top priority in a desert survival situation will probably be water.

1. If there is a limited amount of water available, then food should not be eaten unless the food contains a large amount of water. The metabolism of food and excretion of waste products requires unnecessary usage of water. Water obtained from lakes, streams, wells or springs should be considered contaminated and purified before drinking. Water may sometimes be found by digging at the outside bend of a dry riverbed or stream. Vomiting and diarrhea caused by contaminated water could be quickly fatal in the desert. Rainwater, dew and water obtained from solar or vegetable stills is

relatively pure. Urine, seawater or brackish water should never be drunk in a survival situation. Liquid from radiators is contaminated by glycols and should never be drunk. Many plants such as barrel cactus and traveller's tree and animals such as the desert tortoise contain water which can be used in an emergency. A solar still can be made by stretching a 5'x5' piece of clear plastic over a hole dug in the ground into which vegetation, urine or brackish water has been placed. The sun will cause water to evaporate and collect on the underside of the plastic and then drip back into a container at the bottom of the hole. A tube can be used to remove the water from the container without dismantling the still. The amount of water produced will depend on the amount of moisture in the hole, bone dry sand will not be very productive. Build the still at night to conserve water. Dew, rainwater and edible animals may also be collected in the still as a bonus (see illustration).

2. Shelter is essential if the effects of the sun during the midday are to be ameliorated. The temperature in the desert will vary both above and below the ground. The temperature at the ground surface will be the highest. It will decrease as one goes below the ground and rises above it. Therefore a shelter that protects from direct solar rays and has within it either a trench 12-18 inches deep or a platform 12-18 inches high will be cooler than one in which you must be in contact with the ground. A second roof suspended 12-18 inches above the first will trap a layer of air and decrease the temperature within the shelter. Metal vehicles will be like ovens and it is better to sit on a seat cushion in the shade of an automobile or under the wing of an airplane than to be inside. Try to build the shelter in the shadow of a cactus, tree or large rock. Avoid dry stream beds(arroyo, wadi or dry wash) that may turn into a killer flood in a matter of minutes after a cloudburst miles away. Desert animals will seek out shelter during the day also and may venture into your shade. Reptiles may be venomous and mammals may carry diseases such as rabies or plague.

Most of them can be scared off with a stick or rock.

3. One of the earliest decisions that you will have to make is whether to wait for rescue or to attempt to find your way back to civilization. You need to look at all the factors that may decide your survival. What is the chance that you will be rescued? If you filed an itinerary or flight plan, if you have signalling equipment, a radio or emergency locator transmitter, water, shelter and food; then you probably should stay where you are. Your chances for rescue will be much better if you are near an object such as an airplane or automobile that can be seen by SAR personnel. If you do decide to travel mark a large arrow on the ground in the direction of travel and leave a note stating your direction of travel and plans. Travel in the cool of the night to conserve water, although the footing may be more hazardous. Before travelling in the desert or anywhere, obtain an up-to-date topographic map of the area and learn how to use a compass. Memorize major physical and manmade features so that if you get lost without your map and compass, you will still be able to find a road, river or powerline that may lead to help. Direction can be approximated by using the shadow tip method or a watch during the day or the stars at night (see illustration).

Signalling can best be accomplished during the day using a mirror and reflecting the sun off the mirror towards the horizon in the direction of potential help. If an aircraft is spotted, do not shine the mirror directly on the aircraft but rather alternate flashing the mirror from the ground to the aircraft. A signal such as this can be seen at 30,000 feet. At night a fire or penlight can be seen at great distances also if shone from a high point. A mirror cannot be used up but penlight batteries and firewood can, so wait until you hear the sound of an aircraft or rescuers before signalling by these methods.

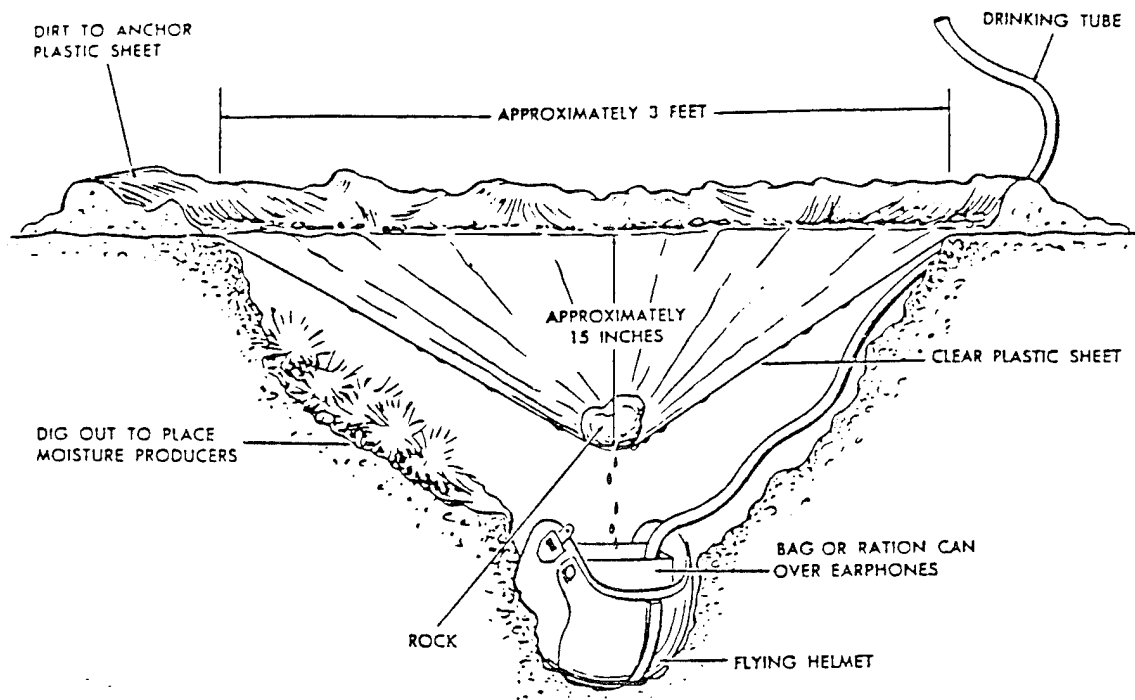
Nature is neutral, neither for us or against us. The game of survival like all games of life is based on our control of nature to the extent that we



need to survive. This includes the nature inside of us as well as outside of us. The first step in any survival situation is to gain control of ourself then try to control those things outside ourself such as climate and terrain.

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Dig a bowl-shaped hole in the soil about 40 inches in diameter and 20 inches deep. Add a smaller, deeper sump in the center bottom of the hole to accommodate the container. If polluted waters, such as body waste, are to be purified, a small trough can be dug around the side of the hole about half way down from the top. The trough insures that the soil wetted by the polluted water will be exposed to the sunlight and at the same time that the polluted water is prevented from running down around or into the container. If plant material is to be used, line the sides of the hole with pieces of the plant or its fleshy stems and leaves. Place the plastic film over the hole and put a little soil on its edges to hold it in place. Place a rock no larger than your fist in the center of the plastic and lower the plastic until it

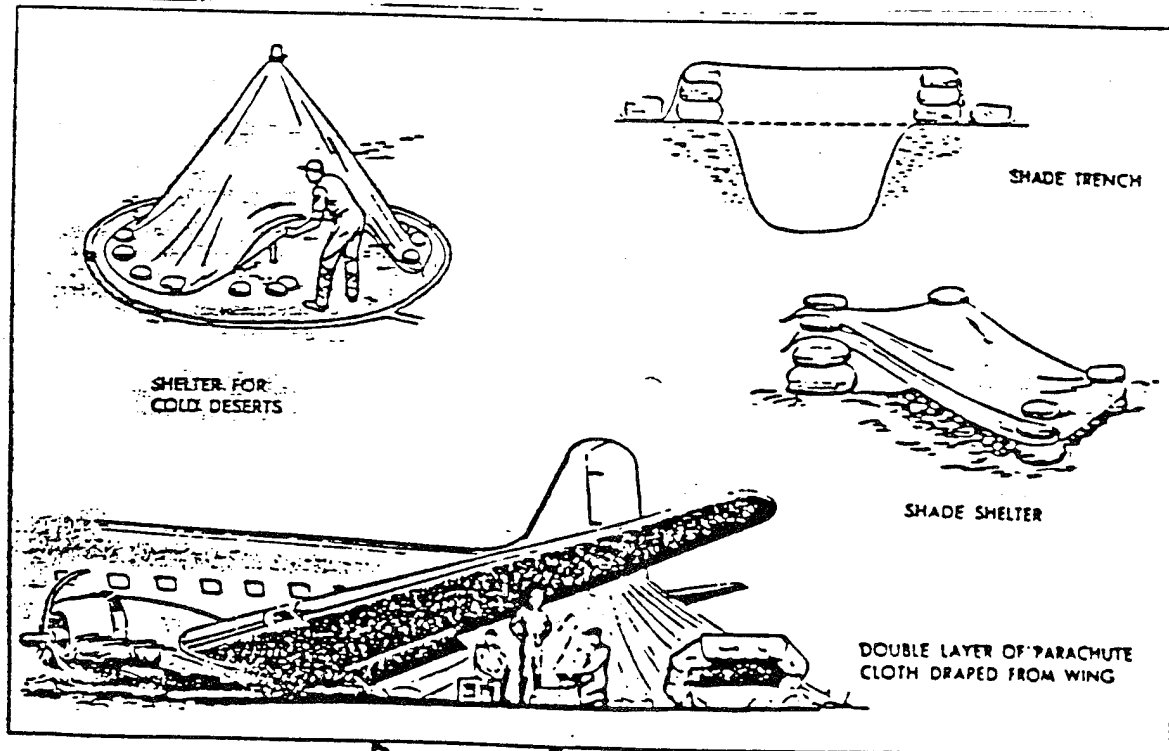
is about 15 inches below ground level. The plastic will now have the shape of a cone.

#### CAUTION

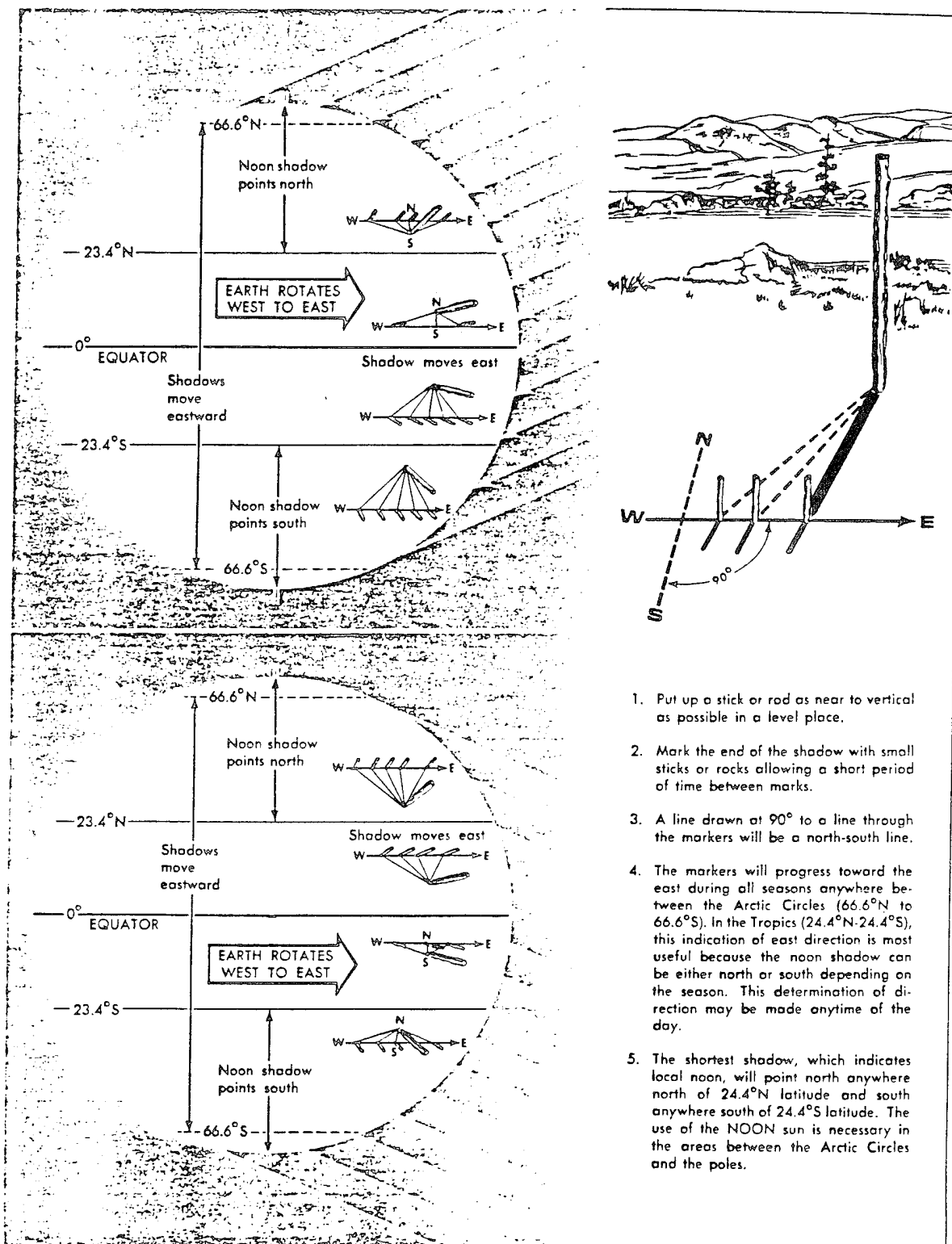
Make sure the plastic cone does not touch the earth anywhere causing loss of water.

Put more soil on the plastic around the rim of the hole to hold the cone securely in place and to prevent water vapor losses. Straighten the plastic to form a neat cone with an angle of about 30 degrees so that the water drops will run down and fall into the container in the bottom of the hole. It takes about one hour for the air to become saturated and start condensing on the underside of the plastic cone.

### SOLAR STILL



### DESERT SHELTERS



*Stick and Shadow Method to Find Direction*

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Saturday, August 12, 1995

# DRESSING FOR COMFORT IN THE OUTDOORS

*NOLS*

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## CLOTHING: WHAT WORKS

by Tod Schimelpfenig, Risk Management Director  
The National Outdoor Leadership School  
Lander, Wyoming

**Introduction:** The National Outdoor Leadership School has for 30 years led multi-week expeditions in all seasons of the year in remote environments, land and sea, desert and mountain, in the Western United States, Alaska, Canada, Mexico, Patagonia, India and Kenya. We routinely take novices into the winter environment for periods of 2-4 weeks on expeditions designed to teach winter camping and skiing. This workshop will share some of our preferred techniques for dressing for the winter environment.

**Objectives:** to present to participants basic principles behind dressing for comfort and safety during winter recreation. Topics will include garment selection and layering, good habits to follow when dressing for the winter, and a brief discussion of different materials.

### Winter Outdoor Clothing: Ten Concepts To Consider.

1. Our clothing serves as *insulation* trapping warm air against the body as protection from the cold and reduces radiative heat loss.
2. Choose design features such as sleeves with velcro closures and zippered or buttoned openings to *ventilate* excess heat and moisture without removing the garment.
3. Choose design features allowing the *freedom of movement* needed to ski, climb, or hike.
4. Select *multi-functional* clothing: garments that are effective in more than one environmental condition.
5. Outdoor clothing must *field dry*. Preferred fabrics, wool or the synthetics, will insulate when wet.
6. Look for *functional designs*; features such as pockets that don't fill with snow every time you fall, hoods that protect the face and neck without impairing vision, shoulders and arms that allow you to reach over your head.
7. Clothing *weight* may be a consideration.
8. Bulky clothing can be difficult to pack. *Compressibility* may be important.
9. The clothing should be *durable* and *repairable*. Rips, tears and broken zippers can

cause critical loss of insulation.

10. *Cost* may be a consideration. There are many inexpensive options available. Surplus outlets are good sources for less expensive, less flashy but functional wool garments.

## **Fabric Basics**

### **Insulators**

- Insulation slows or impedes the transfer of heat energy by conduction. The most important way to stop conduction is to maximize dead air space. Effective dead air space must be small enough that convection currents are not set up in the air cells. Many materials are effective thermal insulators because they trap dead air: down, feathers, fur, dacron, fiberglass, wooden walls and even snow.
- The common outdoor fabrics (wool, down and the synthetics such as pile, polyester, dacron and polypropylene) all provide adequate insulation.
- *Down* provides superior insulation at the lightest weight. It loses its insulating value when wet and is impossible to dry in the field.
- The *synthetics* all provide insulation, retain good insulation value when wet, and dry relatively quickly. Individual fabrics vary in insulation, weight, compressibility, durability, cost, fabric uses, and drying and wicking ability. The synthetics include: polypropylene, capilene, the polyester insulators such as quallofil, thermoloft, holofill, dacron, polargard, kodofil, thermalon, thinsulate, thermore, and the piles such as borglite, polarplus and chinella....
- *Wool* is heavier than the synthetics, durable, insulates well and retains insulation ability when wet. All but the heaviest wools will dry in the field.
- Cotton is a less efficient insulator than wool, the synthetics or down. When wet it increases its thermal conductance nine times. It absorbs moisture and resists drying. It's great in warm weather, however, most of us don't bring any cotton into a cold environment. Many of us call it the "death cloth".

### **Wind/Rain/Snow Shells**

The outer barrier is either a breathable, waterproof or breathable/waterproof shell garment. All three reduce heat loss from convection (wind chill) and provide some degree of protection from rain and snow.

- *Breathable* fabrics shed snow, resist rain and allow body moisture to pass through.
- *Waterproof* fabrics protect from outside moisture. During exercise insulation can become wet from accumulated moisture inside the garment. Not usually worn in the winter due to condensation problem.
- *Waterproof/breathable* fabrics are membranes with pores small enough to block passage to large water droplets while allowing the smaller water vapor particles to pass through. They have proven effective in winter, less so in warm wet weather. Cost can be a drawback.

### **Winter Layering**

Single garments with high insulation ability do not accommodate our tremendous range of metabolic activity. They may work for moderate conditions but would cause

overheating during strenuous activity. Layering is the solution to this problem.

Dressing in layers allows adjustment of the amount of insulation to fit the activity and environmental conditions. Insulation can be added as you cool down, or removed to prevent overheating and sweating. Layers should be successively larger and loose fitting to trap warm air, allow freedom of movement and to allow circulation to the extremities.

#### Underwear Layer

- Usually a layer of light to medium thickness polypropylene or wool long john bottom and top; the basic insulation layer that is only removed in warm weather. Shirts with buttons or zip turtlenecks provide more ventilation options.
- Polypropylene is a common choice as an inner layer that transfers moisture from the skin to the outer layers. Polypro absorbs less than 1% of its weight in moisture.

#### Insulation Layers

- These are one or two layers added as insulation as needed. A variety of fabrics and garments are possible; wool, pile, down, synthetic insulation in sweaters, jackets and coats. Fit the layers over each other without constricting or restricting movement.
- For a winter trip into Yellowstone a usual combination is one polypro layer plus two other insulation layers (wool or pile jackets or sweaters) for the upper body and one polypro plus one additional layer for the legs. An additional outside insulation layer is used in camp.
- Outside insulation layers usually are insulated parkas, insulated pants or snowmobile suits that provide insulation when inactive in camp, on snowmachines and in extreme conditions.

#### Shell Layers

- We wear these almost all the time as our outer layer. They cut the wind and keep us dry in the snow. Breathable wind clothing blocks wind but is not waterproof. Waterproof gear causes insulation layers to become wet from our own body moisture during activity. We generally only wear waterproof gear in the rain.
- Waterproof/breathable fabrics such as goretex, klimate and ultrex are nice alternatives to waterproof gear for winter environments.

#### Head

- It is well known that insulation on the head and neck is important. Scarfs or neck gaitors are popular as light and effective insulators for the neck. They also reduce the bellows effect at the neck. Hats of wool or synthetics should generously cover the ears.
- At NOLS we're fond of large insulated hoods to keep the head and neck very warm. Versatile head insulation provides enhanced heat control.

### Hands

- Mittens insulate better than gloves. Gloves provide better dexterity. Mittens with a silk or polypro glove liner are a good combination when occasional dexterity is needed. Waterproof/breathable or waterproof palm mitten shells keep wool mittens dry.

### Feet

- To keep your feet warm: reduce conduction, keep your feet dry, keep your boots dry and keep your legs warm.
- Many of us develop individualized systems to insulate this difficult area. Common ingredients to these systems include wool socks, vapor barriers, insoles and insulated gaitors. Two pairs of wool socks are common as insulation. Polypro liners work well as smooth inner socks, especially inside a vapor barrier liner.
- Some people use a vapor barrier liner over a polypro or wool sock. This decreases heat loss and keeps outer socks and boots drier. If your feet sweat vapor barriers may be a good idea. Plastic bags or water proofnylon are used, as are neoprene socks.
- Anything tight on the feet or lower legs causes cold toes. Be careful of tight gaitors and boots. The extra pair of socks causing a tight boot fit is often colder than fewer socks.
- Fit your boots with insoles. They make a big difference in conductance through the bottom of a boot.
- Stand on ensolite pads to reduce conduction to the snow.

### **Good Habits For Living Outside In The Winter**

- Avoid sweating: it wets clothing, reduces insulation and enhances dehydration. Slow down or take some clothes off.
- Stay dry. Brush snow off clothing immediately.
- Dry equipment at every opportunity.
- Beware of clothing that constricts at the wrists or ankles. Consider removing watches and rings.
- Carry a needle and thread to repair clothing, and use it.
- Air movement under clothes causing heat loss from openings at the wrist, neck, waist and ankles is known as the bellows effect. It can be reduced by tucking clothes in at the waist, using mittens as plugs at the wrist, gaitors as plugs at the ankles and scarfs as plugs at the neck.
- Reduce conductive heat loss. Use insoles in boots. At rest breaks and in camp stand or sit on ensolite. Place lots of insulation under your sleeping bag.
- Learn to use your hands with gloves and mittens on.



- Respect the cold. Do not fear it.
- The wise outdoorsperson is attentive to details.
- Make clothing or activity adjustments at the first sign of discomfort.
- Be prepared to constantly make adjustments in clothing, nutrition, activity and procedures.
- Warm cold feet on each others stomach.
- Be able to treat hypothermia anywhere and anytime.
- Keep hands and feet warm by keeping head and torso warm.
- It is easier to stay warm than it is to get warm.
- -Stay well hydrated, well fed and well rested.

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Saturday, August 12, 1995

**INNOVATIONS AND  
ATTITUDES IN DIVE  
SAFETY**

*Eric Johnson, MD*

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INNOVATIONS AND ATTITUDES IN DIVE SAFETY  
Workshop for the WMS World Congress, Aspen '95  
Presented by: Eric Johnson, M.D.  
Idaho Emergency Physicians  
Boise, Idaho

As more and more people explore the underwater world through diving, it is critical that they do so smartly and safely to avoid injury. Patterns of behavior will be discussed that may predispose the diver to injury, and will review attitudes in safety to minimize risk. Also, innovations in dive equipment that will assist the diver in minimizing risk and promote safety will be discussed. Intended for those who instruct and care for divers, as well as the personal diver wishing to learn more about safety. This workshop will be classroom style with open discussion.

Objectives:

- to learn about dive safety with regards to patterns safe and unsafe behaviors and practice.
- review ways of minimizing risk and maximizing enjoyment while diving.
- review and discuss equipment innovations.

Handouts will be available at the workshop...

Presenters address:  
2312 N. Cole Rd. Boise ID.  
83704  
208-322-1730  
208-322-1731(fax)

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Saturday, August 12, 1995

**FIELD TREATMENT  
OF HYPOTHERMIA**

*Bruce Paton, MD*

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## HYPOTHERMIA : THE NUTS AND BOLTS OF REWARMING

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### OBJECTIVES :

1. After this presentation the participant will be aware of methods available for rewarming hypothermia victims, both in the field, and in hospital.
2. The relative effectiveness and usefulness of the methods will be reviewed.
3. The indications for rewarming (or not rewarming) will be reviewed.
4. The participant will know when to rewarm, what method to use, and anticipated results.

Hypothermia is defined as a core body temperature less than 35°C. There are many etiologic causes but, physiologically, hypothermia develops when heat loss exceeds metabolic heat production and heat conservation. All rewarming methods depend on reversing this imbalance.

There are four modes by which the body loses heat :

1. *Convection* : the transport of heat away from the body by wind or water.
2. *Conduction* : the transport of heat away from the body by direct contact with a colder surface or medium.
3. *Evaporation* : the loss of heat by evaporation of fluid from the surface of the body, whether water, sweat, or other fluids.
4. *Radiation* : the loss of heat by radiation to cooler elements of the surrounding environment.

There are two modes by which the body regains heat:

1. *Increased metabolic activity* - mainly shivering.
2. *Induced heating*, whether from external or internal sources.

Two other factors are of importance in rewarming: 1) the reduction of heat loss by appropriate insulation and shelter, and 2) 'afterdrop', the continuing fall in temperature that may occur after rewarming has been started.

### REWARMING METHODS :

1. *Passive* : The patient is removed from the cold, dried, insulated and allowed to rewarm spontaneously.
2. *Active, External* : the application of an external heat source. Available sources are:- hot water bottles, hot water baths, chemical heating pads, heated blankets, warm air blankets, putting the victim in a sleeping bag with a rescuer, etc.

3. *Active, internal* : warm, humidified air or oxygen; lavage of body cavities; hemodialysis; extracorporeal circulation. With the exception of warmed air or oxygen, these techniques are not applicable in the field.

## **A: FIELD MANAGEMENT.**

### **Diagnosis :**

1) *By temperature*: There is a continuing discussion about the need to measure a core temperature, and to carry a thermometer that will measure a low temperature.<sup>1</sup> Clinical thermometers measure down to 34°C. For most purposes this is sufficient. If the mercury does not rise above the minimum level, assume that the victim is at least moderately hypothermic. In the field, actions to be taken will not be seriously affected by knowing the temperature. A recent survey of Mountain Rescue Association groups indicated that 73% of groups attempt to take temperatures in the field, and 30% said they measure rectal temperatures.<sup>2</sup>

Swiss mountain rescue groups have, for many years, measured tympanic temperatures.<sup>3</sup> This technique has not been taken up by rescue groups in the US, although the technology is widely used in hospitals.

The ability to measure temperature depends on the availability of an appropriate thermometer, and access to an anatomical site that will give a reliable core temperature. The most reliable sites are rectal, bladder or esophageal. Of these, the rectum is the only site possible in the field; and even that is seldom practical. Oral and axillary temperatures are liable to too many external factors to make them reliable in the field, specially in unconscious patients. If the victim is fully conscious and has not been mouth breathing, an oral temperature may be adequate, in conjunction with other clinical factors, for assessing the severity of hypothermia.

Clinical thermometers, whether for measuring the standard or low range are the most practical to carry into the field. Small battery powered thermometers, with a digital readout, that measure temperatures down to 29.40C are also available. Battery powered electronic thermometers may be convenient for easy readout, but their batteries are subject to malfunction in the cold.

2) *Clinical diagnosis*: Rescue groups may be equipped to measure body temperature, but the average back-country skier, climber or hiker does not carry a thermometer. Reliance must therefore be placed on clinical assessment.

Hypothermia is frequently classified as 'mild', 'moderate', 'severe' or 'profound'. While this classification may have physiological usefulness, it is of limited value in assessing a victim in the field because it depends on knowing the core temperature. Two other classifications may be of more use in the field to help in distinguishing between mild, moderate, and severe cases.

a) *Conscious or unconscious?*: A deterioration in consciousness or mental acuity is one of the first symptoms of developing hypothermia. If the victim is still conscious, core temperature is probably greater than 32°C. The occasional victim may still be conscious with a temperature as low as 28°C. The conscious victim is, in most instances, much less likely to be severely hypothermic than one who is unconscious. Other factors must be taken into consideration, such as the possibility of head injury, drug ingestion, stroke or other conditions that might affect consciousness.

b) *Shivering or non-shivering?* : shivering is the first, and most important, body defense against a falling body temperature. Vigorous shivering can raise the metabolic rate as much as five times and produce more heat than many methods for inducing rewarming. Shivering starts with a fall in core temperature of 0.5-1.0°C. As core temperature falls the vigor of shivering decreases and it usually stops at about 31°C. Shivering will also stop as body temperature rises. If shivering stops in a victim while consciousness is decreasing, then assume that core temperature is falling. If, however, shivering stops while the victim is become more coordinated and feeling better, assume that core temperature is rising.

Consider the following factors:-

1. *Mental status* : confusion, disorientation, apathy, changes in personality such as unusual aggressiveness, inappropriate weariness. All these characteristics develop with a fall in core temperature as small as two degrees. Changes in mentation are frequently the first clue of impending hypothermia. If these symptoms develop in conjunction with appropriate environmental conditions and the onset of shivering, hypothermia can be safely assumed.

2. *Physical status* : lack of coordination; fumbling with gloves, clothes, zippers and buttons; stumbling on the trail; body temperature - skin temperature may be many degrees lower than core temperature. But the temperature of the skin of the abdomen or chest, felt under several layers of clothing may be an adequate indication of core temperature.

3) *Circumstances* : Hypothermia is as common in the summer as in the winter. in making a clinical diagnosis consider the possibility of hypothermia if the patient is shivering (the patient may only be cold and not technically hypothermic), and if other factors of ambient temperature, wind, wetness, inadequate clothing, duration of exposure, lack of food and drink and associated injuries with blood loss are present.

### **Rewarming Decisions :**

1.) *When to rewarm?* The application of external warmth to a shivering patient will only be beneficial if the heat supplied by the external source is greater than the loss of rewarming heat incurred by the cessation of shivering. Not every hypothermia victim needs to be rewarmed. If shivering is vigorous there is no need to rewarm. Shivering is inhibited by the application of warmth to the skin and all methods of external active rewarming have the potential to stop shivering and, therefore, stop the most beneficial method of rewarming. Remove the person from the cold environment, provide dry clothes or a dry sleeping bag, and permit shivering to continue with maximum vigor.

If the victim is unconscious and obviously very cold there are two essential requirements. a) prevent further heat loss. b) provide whatever heat is available. An argument has been raised that a very cold, unconscious victim is in a "metabolic ice-box" and should not be warmed until after reaching a hospital.<sup>4</sup> This argument may be valid if the time to take the victim is short. But over a long journey, the chances are that leaving the victim alone will result in an additional fall in temperature.

Hypothermia reduces oxygen needs and consumption and therefore affords a margin of safety to the patient with a very low cardiac output. But, if a state of profound hypothermia is prolonged the mortality rate goes up and the chances are that core temperature will continue to

fall even further. The most important action, therefore, is to prevent further heat loss.

The need to rewarm immediately is greater after immersion hypothermia than after exposure hypothermia. Most immersion hypothermia is relatively acute. If immersion is prolonged survival is unlikely. Rewarming is an important part of resuscitation of cardio-respiratory function and should be attempted with whatever means are available. The idea that hypothermia is protective to the brain and should, therefore, be continued in drowning victims, is no longer advocated because results have not borne out the theory.<sup>5</sup>

## 2) *How to rewarm in the field?*

For practical purposes, no rewarming method is effective enough to rewarm rapidly in the field. The best that can be hoped for is that heat loss will be reduced and "afterdrop" prevented.

What are field methods are most commonly advocated? In the recent survey of Mountain Rescue Association groups it was found that the two most commonly used methods were - body-to-body contact between a rescuer and victim by putting the two people together in a sleeping bag, and the application of chemical heating pads to the cold victim.

A careful study by Giesbrecht,<sup>6</sup> using volunteers cooled to 34°C showed that not only is body-to-body contact ineffective, but slows down rewarming by diminishing shivering. Two factors influence body-to body rewarming, the temperature of the victim and the surface area of contact between donor and recipient. The total heat lost by an average person to reach a core temperature of 33°C is about 300 Kcals. The heat production of a normothermic heat donor is about 100 Kcals/hr. Thus, even if all the heat produced by the donor could be transferred to the recipient it would not be sufficient to rewarm the victim. And, if shivering is inhibited by heat from the donor, the recipient's recovery is slowed to their disadvantage. If the victim were profoundly hypothermic and the heat donor were wearing very few clothes to maximize heat transfer, there is a possibility that the donor could lose significant amounts of heat. In addition, the area of contact between two people in a sleeping bag is relatively small, and if the heat donor is heavily dressed the chances of significant heat transfer are further reduced.

Several chemical heating pads are available on the market. While they may be effective for warming hands and feet, there is no evidence that they are capable of rewarming a significantly hypothermic victim. For instance, one heating pad on the market ( 7"x9" ) provides 14.5 Kcals. total heat, with a maximum temperature of 51.5°C. A minimum of 20 pads would be needed to provide enough heat to rewarm a 33°C patient - even if heat transfer were 100% efficient.

Other methods that have been advocated for use in the field are : *Airway gas warming* - calculations of the amount of heat that can be transferred by this method also indicate that it should not be expected to rewarm rapidly. But field experience has shown that further heat loss and afterdrop can be reduced, and that there may be benefits from heating the naso-pharynx and pulmonary venous blood that cannot be discerned in elevation of core body temperature. Even a small elevation in the temperature of blood perfusing the coronary arteries may be critical in maintaining myocardial function.

Sophisticated systems are now available for warming and humidifying inspired air or oxygen. One of these which is portable (4 lbs) and has received extensive field trials is the Res-Q-Air® system developed by the University of Victoria, British Columbia, Canada.

*Warmed intravenous fluids:* The transfusion of cold blood and electrolyte solutions



intravenously can lower core temperature rapidly. It is not likely that the volumes of fluid necessary to achieve this lowering of temperature will often be given in the field, but the administration of warmed IV fluids is theoretically better than the administration of cold fluids. Convenient packs, using chemical heating pads, are now available specially for rewarming fluids and insulating the IV tubing and can be used by mountain rescue groups and others and others responsible for the transfer of injured hypothermia victims. (Safe and Warm™EMS Intra-Therm™)

*Exercise:* there are both advantages and disadvantages to exercising a hypothermic patient. Warnings have been given about the danger of exercising victims of immersion hypothermia.<sup>7</sup> This collapse may be due to an exaggerated 'afterdrop' that occurs when a hypothermic patient is exercised. But once the 'afterdrop' has stopped, exercise (specially if combined with shivering) results in a rapid rate of rewarming. Exercise may be an effective choice in the field in a mildly hypothermic victim who is still capable of vigorous activity<sup>8</sup>

REWARMING METHOD	USEFULNESS
Body-to-body contact	Limited or none, may stop shivering
Chemical heating pads	Limited or none, may stop shivering
Warm, humidified air/gas	Reduces afterdrop and heat loss
Warm IV fluids	Little heat, ?prevents further heat loss
Exercise	Effective, beware afterdrop
Warm food/drink	Mostly psychological, limited Kcals.
Warm bath	Efficient; hospital only
Body cavity lavage	Efficient, hospital only, invasive
Warmed external air (Bair Hugger)	Efficient, hospital, special equipment
Extracorporeal circulation	Effective, hospital , severest cases

**Table 1.** Summary of rewarming methods and uses.

## **B: HOSPITAL MANAGEMENT.**

### **Diagnosis:**

Hypothermia should be suspected in all patients found in appropriate circumstances and also in victims of major trauma who may have sustained significant blood loss. Remember! Hypothermia is more common in urban settings than in patients found in the wilderness.

Definitive diagnosis can only be made by measurement of a core temperature. Core temperatures may be measured in the rectum, esophagus, and bladder, and on the tympanic membrane. Esophageal temperatures also measure cardiac temperature. Bladder catheters that incorporate a temperature probe are useful for continuous measurement in patients who also need

urinary drainage and measurement of urine output..

### Management :

*Conscious and shivering* : these patients have a good prognosis and only need to be dried and allowed to warm spontaneously. If there seems to be a need to rewarm, immersion in warm water at 42-45°C is the most rapid and efficient method available and supplies sufficient heat to compensate for any reduction in heat replacement due to cessation of shivering.

*Partly conscious, unconscious, weak or absent shivering and temp below 31°C* : such patients are in danger of continuing to cool and developing an afterdrop of 1-2°C that could reduce the temperature to a dangerous level. Rewarming is necessary.

*Severe hypothermia* : temp <31-30°C. When core temperature is below this level there is increasing danger of cardiac arrhythmias, respiratory failure, metabolic acidosis and an inability to rewarm spontaneously. More energetic rewarming is necessary with full physiological control - biochemical survey, assessment of fluid balance, cardiac output, renal output.

### Rewarming methods :

*Non-invasive* : external warming with electric blankets, water filled piped blankets, warm air blankets, hot water bottles, warm showers or warm bath, warmed humidified oxygen.

*Invasive* : body cavity lavage - peritoneum, pleura, bladder, stomach, mediastinum; hemodialysis; extracorporeal circulation.

REWARMING METHOD	HEAT DELIVERED
Warm air/oxygen	30 Kcal/hr
Heated IV fluids	17 Kcal/L
Forced warm air blanket	>200 W
Cavity Lavage	17 Kcal/L
Hemodialysis; 18-30 L/hr	300-500 Kcal/hr
Hot bath	600-2400 Kcal/hr

**Table 2.** Heat delivered by various methods.

The ideal method for rewarming would be - rapid, non-invasive, permit access for resuscitation, be appropriate for severity of problem.

Notes on various methods :

1. *Warm bath* : several studies indicate that this is the most efficient non-invasive method for rewarming.<sup>9</sup> It is suitable for the conscious patient with moderate hypothermia. Rewarming can be expected at 4-10°C/hr.
2. *Warmed, humidified air/oxygen* : it is essential that the air/gas be 100% humidified so that no heat is lost by humidifying the air in the nasopharynx. The potential heat gain depends on the

temperature of the patient, the temperature of the inspired air and the ventilation rate. Lloyd<sup>10</sup> has calculated that the heat available for rewarming at a body temp. of 30°C with a ventilation rate of 3 L/min is 39 Kcal/hr; and at a ventilation rate of 10 L/min is 55.6 Kcal/hr. The available heat can be expected to raise core temp. 1.1-1.6 °C/hr.

3. *Warm IV fluids* : it seems like a smart idea to give warm IV fluid to a patient who is cold. Experience in ER Depts. and OR's has made it clear that the transfusion of large volumes of cold blood can result in a serious drop in core temperature. But 1 liter of IV fluid @ 45 °C only delivers 17 Kcals. - a trivial amount of heat compared with the heat lost to render a patient hypothermic. IV fluids should certainly be warmed if large volumes are necessary. If only small volumes are being given over a prolonged time, the effort may not be worth the advantage gained.

4. *Body cavity lavage* : body cavities can be used as heat exchange areas. The larger the area of contact, the greater the heat transfer. The peritoneum has, by far, the largest surface area. Effective rewarming can be obtained by lavage through standard dialysis catheters placed in the left and right lower quadrants of the abdomen. Iso-electrolyte solutions at 42-45 ° are infused through one catheter and drained through the other. Exchange 1L fluid q8-10 mins. A serious electrolyte imbalance can be corrected with appropriate changes in the dialysate. This method is also useful in patients hypothermic because of drug ingestion. The toxic agent can be dialyzed out.<sup>11</sup>

There have been several reports in recent years of successful pleural cavity lavage.<sup>12</sup> Two chest tubes are inserted, one high, one low and a drainage system set up. The fluid type, temperature and rates of infusion are similar to peritoneal lavage. If there is a choice, lavage the left chest because greater warming of the heart will be obtained than by warming the right pleural cavity.

The stomach, bladder, and large bowel have also been used; but are small in surface area. A special balloon tube system is needed to lavage the stomach, otherwise fluid escapes into the intestine. The bladder has a very small surface area, and even the large bowel is not nearly as extensive as the peritoneum or pleura. The proximity of the large bowel to the great vessels may help, and, because the bowel has such a large blood supply, there must be some advantageous warming of the venous blood returning to the liver and heart.

5. *Forced warm air*: Flowing warm air over the body is an atraumatic method for warming the skin. The Bair Hugger™ is a plastic tubed blanket with multiple holes on its underside. The blanket is laid over the patient and warm air is pumped through the tubes and escape onto the surface of the skin through the holes. As with most methods that rewarm the skin, this method inhibits shivering, but provides more than enough additional heat to compensate for the reduction in metabolic heat.

6. *Extracorporeal circulation* : If a patient is asystolic and profoundly cold, extracorporeal circulation, as used in cardiac surgery, incorporating a heat exchanger may be the only way to rewarm successfully. Rescue and ambulance groups should be aware that if they have a choice of hospitals to which a victim might be taken, they should always take the victim to the hospital with cardiac surgical facilities.

A patient may be "put on the pump" by two methods. First, the chest is opened and the heart cannulated as in open heart surgery. Second, percutaneous catheters are inserted into femoral artery and vein and a partial perfusion established. Both systems require special

equipment and staff. The latter system is significantly less invasive than the first. The open chest method has the advantage that the mediastinum can be simultaneously irrigated with warm fluid, adding to the rewarming of the heart.

Total heparinization of the patient is necessary with extracorporeal circulation. The method, therefore, cannot be used if there is extensive trauma, and specially if there is a closed head injury with a risk of intracranial bleeding.

REWARMING METHOD	NUMBER	% SURVIVAL
Active External Rewarming	201	62.6
Active Core Rewarming	161	79.5

**Table 3:** Collected data

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# ACCIDENTAL HYPOTHERMIA THERMOMETER TYPES

TYPE	NUMBER
REG. CLINICAL	2
LOW READING	7
ELECTRONIC	7
TAPE	1

MULTIPLE TYPES

# ACCIDENTAL HYPOTHERMIA OTHER REWARMING TECHNIQUES

- PRIORITY 1: Campfire, blankets, drinks
- PRIORITY 2: Vehicle
- PRIORITY 3: Vehicle
- PRIORITY 4: Sarong, Vapor barrier

# ACCIDENTAL HYPOTHERMIA THERMOMETER TYPES

TYPE	NUMBER
REG. CLINICAL	3
LOW READING	13
ELECTRONIC	1

ONE TYPE ONLY

# ACCIDENTAL HYPOTHERMIA TEMP. IN FIELD SINGLE SITE

	NUMBER
MOUTH	6
ARMPIT	1
RECTUM	3
FOREHEAD	1
TYMPANIC	0

# ACCIDENTAL HYPOTHERMIA REWARMING TECHNIQUES

METHOD	PRIORITY 1	PRIORITY 2	PRIORITY 3	PRIORITY 4	PRIORITY 5
WATER BOTTLES	3	5	3	2	
WARM O2	1			2	1
WARM IVS		2	3		1
CH-HEAT		1		1	
CHEM PACK	9	5	4		
SLEEPING BAGS	6	4	6		

PRIORITIES

# ACCIDENTAL HYPOTHERMIA

## GROUP EXPERIENCE

- SEE HYPOTHERMIA : 33
- DID NOT SEE : 1
- MAY-OCT 1-5 CASES : 19
- NOV-APR 6-10 CASES : 4
- 1-5 CASES : 22
- 6-10 CASES : 3
- >11 CASES : 2
- NUMBER OF MISSIONS : 10-1713

# ACCIDENTAL HYPOTHERMIA TEMPS IN FIELD

	NUMBER
NEVER	8
PALPATION	1

# ACCIDENTAL HYPOTHERMIA TEMPS IN FIELD MULTIPLE SITES

	NUMBER
MOUTH	11
ARMPIT	8
RECTUM	8
TYMPANIC	0

The Diagnosis and Treatment  
of Hypothermia by Mountain Rescue Teams  
Hamilton & Paton; 1994

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Saturday, August 12, 1995

**BACKCOUNTRY  
FRACTURES AND  
DISLOCATIONS**

*Joseph Serra, MD*

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Joseph B. Serra, M.D.

## MANAGEMENT OF FRACTURES & DISLOCATIONS IN WILDERNESS ENVIRONMENT

As more people venture into wilderness areas, we can expect more injuries to occur. As a result, more physicians and paramedical personnel will be handling greater numbers of trauma cases in remote and sometimes hostile environment. The trauma seen in the wilderness is much the same as that seen in the urban and hospital setting. However, there are some distinct differences related to diagnosis and management. The physicians and paramedical personnel must rely heavily on good clinical judgment, adequate history taking, understanding the mechanism of injury, and above all, a good common sense approach to the best available treatment methods. Improvisation is a key factor in wilderness medicine.

The scope of this paper involves the management of musculoskeletal injury in the remote settings where early transport and management in a hospital or urban setting is not available. There may be several reasons for this, including distance, environmental risk factors such as weather, terrain, or avalanche affecting the entire party; or lack of an adequate number in the party for safe transport. Also, helicopter evacuation may not be available, or safe. In situations where acute management and early transport are feasible, this is the treatment of choice. Quite often, much can be done to aid the victim with musculoskeletal trauma in the wilderness setting prior to transport and, in some instances, transport is unnecessary if the injury is adequately managed.

This material is directed not only to physicians involved in wilderness experiences, but also to trek leaders, expedition members, boatmen, search & rescue, and any paramedical personnel who might find themselves as the best qualified to aid a trauma victim in the remote setting. With a better understanding of the types of injuries that may occur and their acute management, the proficiency level of those involved should definitely be enhanced.

With these comments in mind, let us review some of the more common fractures and dislocations that may be encountered and discuss the diagnosis and acute management.

### FRACTURES

Diagnostic skills play an important part in fracture management. Without the availability of x-ray, one must rely on clinical evaluation and a common sense approach to management. Decision making process must always include the victim. For example, in a severe ankle sprain where a fracture may be suspected, one would normally immobilize the part, put the victim on crutches with instructions regarding elevation, ice and rest from weight bearing. In the remote setting, in the management of a severe sprain with possible fracture, one has other factors to consider. The needs of the victim must be considered

in relation to his or her desire to ambulate on a suspicious ankle injury; the ability and availability of people to transport the victim; the type of terrain involved in transport; and his or her need or desire to continue carrying a load. Thus, whereas the best medical judgment would preclude weight bearing, the best decision in a remote environment with difficult terrain would be a victim immobilized but bearing weight on the injured ankle with perhaps an ice axe, ski pole or wooden stick for balance. This could be the safest and most reasonable decision based on the situation.

In cases of obvious fracture, management will follow the basic principles of splint immobilization, rest, elevation, ice and compression, as usually provided. Adequate splinting is valuable in the prevention of further damage to vasculature, nerve and muscle; the comfort of the victim; and the prevention of converting a closed fracture to an open one. Splinting may be challenging and improvisation is often necessary, depending on the availability of medical equipment. Obviously, with the larger expeditions and extensive treks, adequate splint material in the form of air splints, wire splints, traction equipment and slings will probably be available. If this equipment is not available, one must consider using items that are carried for other purposes, which would include skis, ski poles, Ensolite pads, metal pack frames, pack straps, webbed strapping, rope, brush and tree branches. Down parkas, topo maps, and newspapers, at times, are quite handy.

#### UPPER EXTREMITY FRACTURES

In cold environments, the examination should be performed, as much as possible, with clothing in place by reaching beneath it. Much can be gained in comparison with the injured and uninjured sides. Immobilizing the arm against the body wall is nature's best splint, and many upper extremity injuries can be very adequately padded and immobilized in this manner with a sling and swathe. The hand and wrist should be free so that pulses may be monitored. Fractures about the shoulder girdle are quite often stable and require nothing more than sling immobilization, ice or snow or cold compresses, if available, and gentle motion of the forearm and hand. A fracture of the clavicle may be treated with a sling or an improvised figure-eight. In the case of fractures of the humeral shaft, it is worth noting that the shaft may be palpable on the medial or inner side throughout its entire length. Therefore, beginning either proximal or distal to the victim's area of complaint, the shaft of the humerus can be palpated and very small, nondisplaced fractures identified. Checking radial nerve function is important in humeral fractures and is done by asking the victim to extend his wrist, digits and thumb. Document the presence or absence of radial nerve function for future reference.

Fractures about the elbow, forearm and wrist should be adequately splinted, incorporating the joints above and below. If at all possible, the elbow should be splinted at 80-90° of flexion to elevate the forearm and hand and, thus, reduce swelling. Active exercise by the victim is quite helpful. Do not flex the elbow more than 90°, even



if possible, because of the potential compromise of circulation. In grossly deformed forearm fractures, gentle traction to obtain better alignment for stable splinting is appropriate and the preferred treatment. Basically, no harm will be done by gently realigning a long bone fracture to its more anatomical position. Applying a splint to a badly angulated forearm fracture is not only difficult, but most often tends to be unstable. Gentle traction with an assistant applying counter-traction to the upper arm results in an overall improvement with a negligible risk of creating further vascular or neurologic damage. The stability provided by a solid splint is worth the effort, especially in long and difficult transport. Peripheral pulses must be monitored before and after realignment. They should also be checked periodically to ensure that a splint wrap is not too tight. Fractures of the distal radius and ulna may be adequately splinted in the position found, unless there is a compromise of circulation. Place the hand in a position of function with soft material, such as a rolled up glove or sock or wool cap, in the palm and then immobilizing the hand, wrist and forearm in a splint. It is important to give the victim the responsibility of notifying you of any changes in sensibility or level of pain.

Fractures of the hand are fairly common and often related to dislocations at the level of the proximal or distal interphalangeal joints. Phalangeal fractures should be reduced and splinted in a position of function, not in an extended position on a tongue blade splint. Early after injury, these fractures can be reduced with only minimal discomfort. Hours after the injury, swelling and pain make realignment more difficult and if Lidocaine is available for a digital block, this is most helpful. If not, use of an ice compress and very gentle traction can realign these fractures of the hand without significant discomfort. When immobilizing the digits, keep them in a position of function, whenever possible, and use adjacent digits for splinting, when appropriate. However, one must consider the need to have normal digits available for usage, depending on the victim's requirement. When splinting of the entire hand is advisable, a suitable splint may be made by placing the entire hand in a functional position with an Ace bandage or a suitable similar sized material in the palm of the hand and then wrapping the entire hand with an Ace bandage or Kling dressing. Even torn strips of clothing can be used for a suitable hand splint.

#### LOWER EXTREMITY FRACTURES

Fractures about the hip and femoral shaft present major problems in wilderness medicine, primarily due to the inevitable transport problem and the necessity to maintain adequate traction for extended periods of time, as in the case of a femoral shaft fracture. First of all, in fractures of the hip, the typical position of external rotation and shortening may or may not be present. The fracture may be an impacted femoral neck type or an acetabular fracture. It may be difficult to differentiate between the various types that might occur. Therefore, if a victim has sustained significant trauma and has painful motion in the region of the hip, plus pain with weight bearing, this patient should be protected from weight bearing and,

generally, this means the victim must be carried either in a makeshift litter or on a sled. Suspected fractures about the hip and pelvis need not be placed in traction, owing to the difficulty of maintaining adequate traction, which very often is not necessary. In suspected fractures of the pelvis, it is imperative that the victim be observed for pending shock due to the significant blood loss often associated with these fractures. There may also be possible bladder trauma and the victim must be checked for hematuria.

Fractures of the femoral shaft require traction. In a major expedition or in an extended trek in remote regions, the expedition doctor or paramedical person in charge should plan ahead for the type of traction that will be utilized if a femoral shaft fracture should occur. There are commercial traction devices available which are lightweight, easy to apply and fairly efficient. Improvising femoral traction can be satisfactory, but should definitely be practiced prior to the actual event so that everyone understands and is familiar with the plan. The fracture of the femoral shaft is basically the only fracture that must be treated in traction for many important reasons. The most important is the fact that traction reestablishes normal length and conformity of the musculature and this tends to tamponade the bleeding which occurs in the thigh. A victim with a femoral shaft fracture can lose more than a liter of blood easily and if the fracture is movable and the thigh unstable, this bleeding can continue. In addition to that, the fracture fragments may cause further vascular damage. The additional reasons for femoral traction include the relief of pain, stability of the fracture fragments, prevention of converting a closed fracture to an open one, and reduction of further soft tissue damage. Once a fractured femur has been diagnosed, someone should be assigned to apply manual traction to the extremity with the patient protected against the environment until the traction device is placed. A general rule of how much traction to apply is 10% of the victim's body weight or until the pain is relieved. Additional immobilization of the fractured extremity to the uninjured leg with adequate padding is also quite helpful. When long transport is anticipated, place padding behind the knee to create 5-10° of knee flexion because this will make the extremity much more comfortable than if the knee is fully extended in traction. Frequent monitoring and documentation of circulation is indicated. It is not necessary to remove the shoe and sock in most instances. The dorsalis pedis pulse can be palpated within the sock and, also, a gross determination of sensation and skin warmth can be made by palpation. The victim can relate the sensation of numbness or tingling in the toes, if this should occur. The determination to remove footwear should be left to the person in charge and based on the consideration of all pertinent factors.

An extended transport over very uneven terrain is extremely difficult and requires, at the minimum, six to eight people to alternate in carrying the victim and also to carry packs and equipment. Therefore, if there is a reasonable alternative, including helicopter evacuation, it should be strongly considered.

Patellar fractures may result from a fall directly on the knee and may be difficult to differentiate from a severe contusion to the patella unless there is an obvious deformity. Therefore, a victim with such an injury should be immobilized in a cylinder type splint from groin to ankle and may be permitted to walk with some assistance, if terrain and other factors dictate that this is the best course of action. An Ensolite pad wrapped about the knee and taped in place makes an excellent cylinder splint to immobilize injuries about the knee.

Tibial fractures require adequate splinting, but no traction. Angular deformities should be gently corrected to allow more stable splint immobilization. Splint materials could be anything from air splints to materials mentioned earlier. In an open fracture with marked deformity, the best approach is to cleanse the protruding bone ends with any antiseptic available or even plain soap and water. A sterile bandage or the cleanest available material should be placed over the wound and the fracture then treated as a closed fracture would be, insofar as the application of a splint is concerned. Broad spectrum antibiotic therapy is indicated, if available. The point here is that correction of gross angular deformity and adequate splint immobilization takes precedence over concern regarding protruding bone ends.

Air splints are quite useful if handled properly. Basically, this means that circulation to the extremity and the splint pressure should be monitored hourly. Keep in mind changes in splint pressure due to loss or gain in altitude. Of the basic types of air splints available, the type with the zipper and screw type air lock work better than the lighter weight, self-sealing type. Extreme changes in temperature will affect the self-sealing feature of these lightweight splints. The others are of heavier material, but function much better.

Fractures about the ankle may be difficult to assess. The earlier the examination can be done, the more information you will obtain. Take all steps possible to adequately immobilize, then elevate and apply ice, cold water or snow to the injured extremity to prevent excessive swelling. A well wrapped compression dressing is also quite helpful. In fracture-dislocations of the ankle, early gentle reduction of the deformity is extremely important and most often quite easy to do. Simply holding the foot and applying gentle traction to the heel using the victim's leg as counter-traction can greatly improve the deformity. The sooner this is done, the better. Therefore, it should be done by anyone who understands the advantages and is comfortable with trying to improve the position of the fractured ankle. Basically, the damage has already been done by the fracture-dislocation and, therefore, any attempt at improving the position will have a beneficial effect on circulation. This also makes splinting more stable and comfortable. Fractures in the ankle area may be splinted very well with a down parka or other comparable gear which can be pinned in place, having the affect of a pillow splint.

In cases of severe crush injury of the lower leg, compartment syndrome must be considered and recognized. Management of the compartment

syndrome in a remote setting should be left to the discretion of the physician faced with this problem. As the physician is qualified and the victim is aware of the risks, it is conceivable that a fasciotomy could be the treatment of choice in a remote environment.

In summary, for fractures of the lower extremity, the physician or paramedical personnel should follow the same basic principles that apply in the urban setting. However, they must keep an open mind as to the victim's needs in regard to his or her ability or desire to ambulate if at all possible. Also, recognize the need for several people to carry the victim if a long transport is inevitable.

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Saturday, August 12, 1995

**MEDICAL SELECTION OF  
PARTICIPANTS IN  
WILDERNESS VENTURES**

*Blair D. Erb, MD*

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MEDICAL SELECTION OF PARTICIPANTS

IN WILDERNESS VENTURES<sup>(C)</sup>

Blair Dillard Erb, M.D., FACP

Workshop #54

8:00 a.m. - 10:00 a.m.

Saturday 12 August 1995

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PURPOSE: To provide the basis for constructing the medical assessment of individuals considering wilderness ventures.

- OBJECTIVES:
- 1) To classify wilderness ventures by demands.
  - 2) To classify participants according to medical and functional capacity.
  - 3) To identify components of a medical examination.
  - 4) To provide the basis for the design of a medical examination according to venture demands.

Physicians are often asked to advise individuals regarding participation in wilderness activities. Not only is this process important for the health, safety, and even survival of the individual, but also to the success of the mission and the safety of others involved in the activity.

Matching the individual with the task is aided by classifying each. Wilderness ventures, classified by physical demands and environmental exposure, can include:

(1) Extreme performance ventures (e.g. Mt. Everest or Mt. McKinley climb), (2) High performance ventures (remote hunting activities, jungle trekking), (3) Recreational activities (e.g. Alpine hiking, National Park trail walking), and (4) Therapeutic activities for those with illness or disability.

Individuals interested in wilderness ventures can be classified according to their health and functional capacity to include: (A) Demonstrated high performance individuals, (B) Healthy, vigorous individuals, (C) Healthy, "deconditioned" individuals, (D) Those with risk factors, and (E) Those who are manifestly ill.

These classifications are outlined in Table 1.

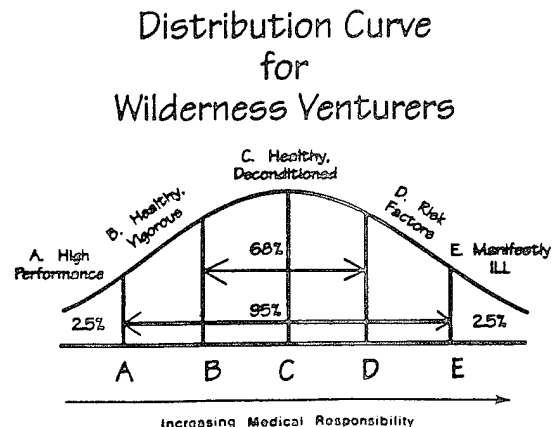
### Classification of Wilderness Ventures and of Participants in Wilderness Ventures

#### I. Classification of Wilderness Ventures

- A. Extreme performance ventures
- B. High performance ventures
- C. Recreational activities
- D. Therapeutic activities

#### II. Classification of Participants in Wilderness Ventures

- GROUP A = Demonstrated high performance individuals
- GROUP B = Healthy, vigorous individuals
- GROUP C = Healthy, "deconditioned" individuals
- GROUP D = Those with risk factors
- GROUP E = Those who are manifestly ill



Armed with these classifications, a physician can approach a prospective candidate with an examination appropriate for the individual and for the venture.

In the process of developing the content of such an examination, we sought the opinion of wilderness leaders who were experienced in the selection process. The response of 60 wilderness leaders to a questionnaire served as the basis for the medical content of a generic medical examination.

There were five categories of characteristics included:

(1) Personal characteristics, (2) Historical characteristics, (3) Medical components, (4) Physiological components, and (5) Psychological characteristics. Items included in each category are listed in the appropriate column in Table 2. Characteristics associated with Category 5, psychological, were sprinkled throughout the other 4 categories because of the very personal nature of the questions. The results of the survey were used to "weight" the relative value of the various characteristics. For example, the highest relative value score for problems associated with a venture were "demonstrated problems with psychological or interpersonal relationships", a clear psychological factor. The least valuable predictors were physiological. The traditional medical examination was of value, but the results underscore the importance of the history in completing a physician examination. The experienced participant, i.e. the old **"SALTY DOG"** is perceived to have proven the capacity to function and the wisdom to avoid circumstances with the potential for physical or psychological difficulties.

This perception shifts the physician's examination in the direction of a form of "Salty Dog Science", which requires experience on the part of the physician in the ventures being considered, the professional skills required to obtain a reliable interview with the candidate, and the wisdom to match the participant with appropriate activities.



### PERCENTAGE OF RESPONDENTS RECOMMENDING EXAM

Percentage of 60 respondents to a questionnaire asking wilderness group leaders to rank items from a medical examination for selecting participants in wilderness ventures.

TABLE 2

# COMPONENTS OF THE PHYSICIAN'S EXAMINATION

Results from the survey can be used to construct the content of the physician's examination. Emphasis on certain components of the exam will vary according to the characteristics of the venture. The five categories of ventures have as a common denominator the requirement that prospective candidates should have a thorough history. Demonstrated high performance individuals require less "hands on" examination and technical testing than subjects with some limitation in their performance predictors. Table 3 indicates the emphasis of various components of the examination based on the classification of the prospective participant and the nature of the proposed wilderness venture.

Table 3.

## COMPONENTS OF EXAMINATION EMPHASIZED IN SELECTION OF PROSPECTIVE PARTICIPANTS IN WILDERNESS VENTURES

Classification of Characteristics of Individual	<u>CLASSIFICATION OF VENTURE</u>			
	Extreme Performance	High Performance	Recreational	Therapeutic
A. Demonstrated High Performance	2,3, <u>5</u>	2,3, <u>5</u>	2	*
B. Healthy, vigorous	2,3,4, <u>5</u>	2,3, <u>5</u>	<u>2</u>	<u>2</u>
C. Healthy, "deconditioned"	1,2,3,4, <u>5</u>	2,3,4, <u>5</u>	2, <u>4</u>	2, <u>3,4</u>
D. Risk Factors	1,2, <u>3,4,5</u>	1,2, <u>3,4,5</u>	2, <u>3,4,5</u>	2, <u>3,4,5</u>
E. Illness	*	*	1,2, <u>3,4,5</u>	1,2, <u>3,4,5</u>

### CATEGORY OF COMPONENT CHARACTERISTICS

1. Personal
2. Historical
3. Medical
4. Physiological
5. Psychological

All categories of characteristics should be considered in the examination of prospective participants, but characteristics listed above with **bold underlined** numbers are of prime importance. Lower case numbers should also be closely considered.

\* Individualized assessment indicated.

All categories of characteristics should be considered in the examination of each prospective participant, but certain characteristics are of greater importance in certain circumstances. For example, the high performance individual who wants to take part in recreational activities has very little medical requirement. On the other hand, a subject with demonstrated cardiovascular disease who wants to participate in recreational activities should have a very careful examination, including physiological testing if a therapeutic component is considered. Of course, physician judgement is essential in any examination, and this table is used simply as a guideline.

Just as in any traditional medical examination, the history is the most critical component. The physical examination and laboratory data may lend some information. Certain physiologic testing may be of value in resolving questions raised by the history and the physical components. The interpretation of the results are based on the physician's judgement and experience. Salty Dog Science demands classic medical skills, a physician experienced in similar wilderness ventures, and the judgement that aids the physician in determining that the individual fits the task.

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Saturday, August 12, 1995

# **WILDERNESS MEDICINE IMPROVISATION**

*Eric A. Weiss, MD*

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**IMPROVED PATIENT CARE TECHNIQUES:  
1001 USES FOR A SAFETY PIN**

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# **IMPROVED PATIENT CARE TECHNIQUES: 1001 USES FOR A SAFETY PIN**

**By Eric A. Weiss, M.D.**

## **INTRODUCTION**

Many environmental disciplines are juxtaposed under the central theme of Wilderness Medicine. Although experts in altitude illness, hypothermia, desert survival and others focus on a specific topic, to provide effective medical care in the wilderness, they must all possess one common talent -- the ability to improvise.

The excitement of wilderness medicine is in the immediacy of care and the challenge of combining medical science with creativity to manage medical problems. Providing health care in remote settings challenges the ingenuity and skill of the health care provider. The paramount ingredients necessary to provide successful medical care in the wilderness are:

1. A basic fund of medical knowledge,
2. Essential diagnostic and first-aid tools,
3. The ability to improve and use a limited amount of resources in a creative fashion.

## **COURSE OBJECTIVE**

This workshop is designed to challenge your imagination, free your creative spirit, and lighten your first-aid kit. By exploring methods of using common wilderness items in an improvised fashion we will broaden the capacity of our first-aid kits and remove less essential items. At the conclusion of this workshop you should feel more comfortable managing wilderness emergencies with a modicum of technical supplies.

## THE TRIANGULAR BANDAGE MYTH

Experienced outdoors people will always find imaginative ways to limit the size and weight of the equipment they must pack along on their trips. One of the most ubiquitous items carried in a first-aid kit that is also one of the least important is a triangular bandage. Traditionally used to construct a sling and swath bandage for shoulder and arm injuries, this bulky and cumbersome component can be easily substituted with three safety pins. Pinning the sleeve of the injured arm to the shirt front will effectively immobilize the extremity against the body. If the patient is wearing a short sleeved shirt, fold the bottom of the shirt up over the arm creating a pouch. Safety pin the end to the sleeve and upper part of the shirt to secure the arm in a splinted position. Triangular bandages are also used as a pressure wrap. Other items commonly found on outings such as socks, shirts, belts, webbing, pack straps or ace bandages can be used just as effectively.

## IMPROVISED WOUND MANAGEMENT

Irrigation of a wound in the Emergency Department is an essential step in wound management. Normally a large syringe with a catheter on the tip is employed to create a forceful irrigation stream. Sterile saline or dilute providone-iodine is used as the irrigant solution. Carrying this much equipment into the wilderness is cumbersome and unnecessary. Using improvised techniques, wound care can still be performed with a modicum of supplies. Here is the recipe:

1. Fill a large sandwich bag with one-half or one liter of back country water (a water bottle can be used to measure the amount).
2. Sterilize the water with Iodine tablets, Iodine solution or Povidone Iodine (Betadine).
3. Add 9 grams of granular salt (one rounded tablespoon) to one liter of sterilized water to produce sterile normal saline.
4. Seal the top of the bag.
5. Puncture the bottom of the bag with a safety pin and widen it slightly by turning the pin in a circle.
6. Squeeze the top of the bag while holding it over the wound to begin irrigating.

## SPLINTING

The key ingredient in wilderness splinting is improvisation. It is not necessary to carry any type of pre-fabricated splinting in your first-aid kit since suitable splinting material is always available.

On a ski trip, skis and poles can be employed in the construction of a traction splint for a Femur or Tibia fracture. On white-water trips, canoe or kayak paddles can be used in a similar manner. The malleable aluminum stays in internal frame packs can be molded into a sugar tong, a coarctation splint for upper extremity fractures. Many packs have detachable hip belts that make excellent cervical collars. Two packs lashed together can provide a backboard or stretcher in which to transport an injured patient. Another method of transporting a person is by cutting two holes in the bottom of your pack for legs and then using the pack as a basket.

A life jacket can be molded into a cylinder splint and used as a knee immobilizer or into a pillow splint for the ankle. Two paddles threaded through the inside of two zippered life jackets will produce another type of stretcher. Other material that can be used for splinting include sticks or tree limbs, rolled up magazines or newspaper, ice axes, tent poles, and dirt filled fanny packs. Air bags used as floatation for kayaks and canoes can be converted into pneumatic splints for arm or ankle injuries. The minicell walls found in most kayaks can be removed and used as a backboard. It is also easily cut to provide any size splint needed. Next time you go on an outing, leave your store bought splints behind and take along your creative spirit instead.

## THE VERSATILE FOLEY CATHETER

Urinary retention is not an uncommon problem during high altitude sojourns. The combination of cold weather, long hours in the sleeping bag and anticholinergic medicines such as antihistamines can all predispose one to a distended, antonic bladder. A foley catheter is crucial for relieving this malady.

There are many other uses for the foley as well. It can act as a tourniquet to draw blood, start IV's, or stop bleeding. Once lubricated, it can be inserted into the nose for use as a tamponade for posterior epistaxis. When endoscopy is unavailable, it can be used to remove esophageal foreign bodies by inserting the catheter past the foreign body and then inflating the cuff to catch the obstruction and pull it out.



When cut to a smaller length, the foley can be used as a nasal airway. A foley with a stint inserted to keep it from collapsing can be used as a chest tube to relieve a tension pneumothorax.

The foley catheter can even act as a makeshift stethoscope. Simply place the diaphragm from an old stethoscope or a piece of paper rolled into a funnel with a piece of x-ray film attached into one end and an ear piece into the other for wilderness auscultation.

This simple stethoscope can also act as a primitive x-ray machine. Since sound transmission is weaker through a broken bone, one can suspect the presence of a fracture by listening for a dampened sound while tapping a finger along the injured limb.

And, finally when you return to the car after your outing and need some gasoline, don't forget that the foley can be used to siphon gas from your neighbor's tank.

## IMPROVISED USES OF A SAFETY PIN

1. Two safety pins can be used to pin the anterior aspect of the tongue to the lower lip to establish an airway in an unconscious patient with an obstruction of their airway due to relaxation of the tongue and posterior pharynx.
2. Replacing the lost screw in your glasses to prevent the lens from falling out.
3. Improvised glasses - Draw two circles in a piece of duct tape where your eyes would fit. Use the pin to make holes in the circles and then tape this to your face. The pin holes will partially correct myopic vision.
4. Neurosensory skin testing.
5. Irrigation of wounds with a safety pin punctured sandwich bag.
6. Removing embedded foreign bodies from the skin.
7. Draining an abscess or blister.
8. Relieving a subungual hematoma.
9. Fish hook.
10. Improvised sunglasses.
11. Finger splint (mallet finger).
12. Sewing needle using dental floss as thread
13. Holding gaping wounds together
14. Replacing a broken zipper on clothing.
15. Holding gloves or mittens on your coat sleeve.
16. Unclogging jets in camping stoves.
17. Pin triage note to multiple victims.
18. Removing corneal foreign body (with ophthalmine).
19. Sling and swath for shoulder or arm injuries
20. Fix ski binding.
21. Removing thrombosed hemorrhoid.
22. Pin strap on shirt tightly around chest for rib fracture support.

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Saturday, August 12, 1995

**BLOOD ON THE ROCKS:  
HELICOPTER USE IN  
NON-CRITICAL MOUNTAIN  
RESCUE OPERATIONS**

*Bill Clem, MD*

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**BLOOD ON THE ROCKS:  
HELICOPTER USE IN NON-CRITICAL MOUNTAIN RESCUES  
Bill Clem, MD, FACEP  
National Medical Advisor, Mountain Rescue Association  
Golden, Colorado USA**

If one simple statement can be made about Mountain Rescue operations throughout the World over the last 15 years, it is that where helicopters are available, they have replaced ground-based rescue operations. The helicopter's main advantages, quick access to the injured patient and rapid transport, are well acknowledged. But as dependence on helicopter operations has increased, one significant fact continues to be ignored. Use of the helicopter allows the use of less experienced, perhaps poorly trained personnel. The Tool is being confused with the Task. The Task is the rescue of an injured, immobile party in an adverse environment, namely the mountains. The Tool is a complex collection of moving parts each whirling in opposition to each other, the helicopter. The helicopter is just another tool in the toolbox of the experienced mountain rescuer. It has the amazing capability to carry the inexperienced and poorly trained very quickly into a hazardous situation. An analogous situation might be the Coast Guard performing an open water ocean rescue using a rescue swimmer who needs water wings to stay afloat because he cannot swim. Where once we could depend on the mountain itself to discourage those of noble intent but little experience, the helicopter leaps over such obstacles and can easily allow the pilot and crew to go beyond their capabilities.

For the mountain rescuer to use the helicopter as a tool of access and transport he must understand the flight performance and limitations of its use. We will review a simple method to analyze the capabilities of a generic helicopter. The pilot's experience is often difficult for the non-pilot to evaluate. We will review a successful pilot evaluation program that could be used to evaluate the skills of a pilot before they are needed on an actual operation. And finally, we will review several accidents involving helicopters engaged in mountain rescue operations, including an analysis of the need for helicopter evacuation.

Following the presentation, the participant should be able to identify several key factors influencing helicopter performance and the applicability to a particular rescue. In addition, the participant should be able to outline some of the risks and benefits which must be weighed when incorporating a helicopter into a mountain rescue operation.

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Saturday, August 12, 1995

# IMMUNIZATIONS

*David Shlim, MD*

## Immunizations and Prophylaxis for Travelers

David R. Shlim, M.D.  
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Learning Objectives: Following this presentation, participants will be able to:

1. Better understand how vaccine recommendations for travelers are developed.
2. Know which vaccines and immune globulins are appropriate for various destinations and situations.
3. Compare vaccines when there are multiple products available to prevent the same illness.

Note: The following has been adapted from a handout that is given out at the CIWEC Clinic in Kathmandu, Nepal. Therefore, the language is adapted to lay understanding, and the audience is intended to be those that are considering foreign travel for themselves. The handout, however, has been updated for this syllabus.

### Introduction

*Every decision to take a vaccine to prevent an illness is essentially a decision that the short term expense and slight discomfort (and slight risk) is worth the improved chance of avoiding an unpleasant or potentially fatal illness. The following recommendations are based on the advice of international agencies such as the World Health Organization and the Centers for Disease Control in the United States, coupled with our local experience. Vaccine recommendations occasionally vary from Europe to North America, usually in regard to the exact schedule of giving the vaccine. The results of vaccination can be the same with different schedules.*

*The protection that can be gained from vaccines varies from 50% to almost 100%. So remember that even if you have taken a vaccine you might still get the disease, although you will have greatly reduced your chances of getting ill.*

## **Travel-Related Vaccines and Immunoglobulins**

### **For the Prevention of Hepatitis A:**

Hepatitis A is a virus that infects the liver causing profound fatigue, loss of appetite, jaundice, and weakness. On rare occasions the illness can be fatal. It is now almost entirely preventable, using one of two strategies. Every traveler who is not known to be immune to hepatitis A based on prior infection, and who feels that he or she will be at risk for travelers' diarrhea, should consider hepatitis A prophylaxis, even for a short journey.

**1. Gamma Globulin:** Also called "Immune Serum Globulin." This is not a vaccine, but a collection of antibodies purified from the blood of an immune population. In travelers it is used to protect against hepatitis A. Our experience in Nepal suggests that it is very effective in preventing hepatitis in foreigners (almost 100%). Although there is now a vaccine against hepatitis A, gamma globulin can still be appropriate for short-term travelers who do not plan future trips. Gamma globulin, although derived from human blood, has repeatedly been shown to represent no risk of transmitting the HIV virus which causes AIDS. We recommend taking one milliliter of gamma globulin for each month of intended travel, plus an extra milliliter, to a maximum of five milliliters for four months protection.

**2. Hepatitis A Vaccine:** This is a new vaccine, available for about 3 years in Europe, and just recently introduced into the United States. It is a safe vaccine, produced from killed hepatitis virus, which offers long lasting protection against hepatitis A, making gamma globulin injections no longer necessary for people who take the hepatitis A vaccine. Since hepatitis A virus is spread through fecal contamination, travelers and residents in developing countries are at constant risk if they do not take either gamma globulin or the new vaccine. Two dosing regimens are currently in use: A single strength (720 i.u.) injection followed by boosters at one month and six months. In the United States a double strength vaccine has been approved (1440 i.u.) which is given initially, with one booster at 6-12 months. Both regimens offer equal protection. Duration of protection is thought to be at least 5-10 years, if not longer.

### **For the prevention of Hepatitis B:**

Hepatitis B is a virus transmitted through infected bodily fluids, such as blood and semen. It is not usually a random risk of travel, but is highly endemic in some developing countries, increasing the risk of being infected by emergency hospital treatment, or unprotected sex. Since hepatitis B can sometimes cause a life-long infection, leading to liver failure and death, prevention strategies are being developed that may include

universal immunization against hepatitis B in childhood. Therefore, although not specifically required for most foreign travel, the traveler should have a low threshold for taking the vaccine if they think their life style will put them at risk.

**Hepatitis B Vaccine:** This is a well established vaccine with high safety and efficacy. It is made from either killed virus, or genetically engineered viral particles. Side-effects are minimal. The regimen consists of an initial injection followed by boosters at one month and six months. Current thinking is to give a booster every ten years.

#### **For the prevention of Meningococcal Meningitis:**

*Neisseria meningitidis* is a bacteria that can cause a severe and usually fatal infection in the absence of prompt medical care. It has been shown to occur rarely among trekkers in Nepal. However, since trekkers are usually several days away from medical care, the few cases that occurred while trekking were all fatal. Therefore, the vaccine, which is safe and effective, with few side effects, is still recommended for travelers to Nepal who will be away from medical facilities for a length of time. Meningitis is spread through coughing or sneezing in a closed environment, with the bacteria entering your body through the nose and mouth. Any traveler who is concerned about the risk of meningitis in Nepal should be offered the vaccine, regardless of their itinerary. The vaccine is also recommended for all pilgrims who travel to Mecca.

**Meningococcal Meningitis Vaccine:** The vaccine consists of the purified surface of the meningococcal bacteria, making it quite free of side-effects. The vaccine is considered 90% effective, and the protection from a single shot lasts five years in people over age five, and two years in children under five.

#### **For the prevention of typhoid fever:**

Typhoid fever is caused by a bacteria called *Salmonella typhi*. This organism, and a closely related organism called *Salmonella paratyphi*, can produce an illness characterized by fever, headache, and profound fatigue. Untreated, it can last for up to a month, with a mortality rate of 15%. Healthy tourists, who are diagnosed in the first week of illness have almost no chance of dying, but it is a miserable illness that can take a month to recover from. Therefore, it is worth trying to prevent. Currently, there are three licensed vaccines available, which are discussed below.

**1. Killed Whole Cell Typhoid Vaccine:** This is the original typhoid vaccine, consisting of *S typhi* organisms that are killed by heat or chemicals, and then injected intramuscularly. Side effects are higher than with the other two vaccines. However, the killed whole cell vaccine may be partially protective against *S paratyphi A* infection, which otherwise accounts for about 35% of the risk of typhoid or paratyphoid fever in some destinations (such as Nepal). Typhoid infection is acquired by eating food or water contaminated by



infected stool. Due to the efforts that most travelers make to avoiding eating contaminated food or water, the typhoid vaccine has been shown to be more effective in travelers than in studies performed on local populations. The injectable vaccine is probably 90-95% protective in a population that is trying hard to avoid stool contamination.

**2. Oral Typhoid Vaccine:** This vaccine consists of live *S typhi* organisms that have been biologically modified to not cause illness, but to still induce an immune response. It has no effect on *S paratyphi* infection. The success of the vaccination is linked to the successful delivery of the live organisms to the appropriate portion of the intestine. The main obstacle is the barrier of hydrochloric acid in the stomach. The current solution is to place the organisms in an enteric coated capsule which is supposed to dissolve beyond the stomach. The erratic dissolution of these capsules may account for the 60-65% protective efficacy of the oral tablets. This may be improved upon shortly when the vaccine becomes available as a packet of dried organisms that would be reconstituted in water and drunk as a solution. Side effects are almost non-existent. The capsules come as a package of three or four (depending on your country of origin), to be taken on an empty stomach every other day. The capsules can't be taken if you are on antibiotics or malaria prophylaxis.

**3. Capsular Polysaccharide Typhoid Vaccine:** This is a well-designed vaccine that consists of a single shot offering up to three years protection, with minimal side-effects. It is very specific for *S typhi*, and wouldn't offer protection against *S paratyphi A*. It offered 78% protection in a high risk Nepalese population. It is a valid alternative to the oral vaccine, particularly if time is short, or you are already taking antibiotics or malaria prophylaxis. It can also be given to children who can't swallow the oral capsules.

#### **For the prevention of Japanese B Encephalitis:**

This disease is caused by a virus carried by mosquitoes in rural areas of southern Nepal, northern India, Burma, Thailand, Malaysia, and Indonesia. It is also present in parts of China. The virus can cause a severe and often fatal infection of the brain. The risk to travelers seems to be extremely low. There are very few cases recorded among casual tourists. Several other cases have been reported among aid workers, students, and foreign soldiers in endemic areas during the past 12 years. The Israeli public health service recommends the vaccine to all of its citizens who travel to Asia. Few other national or international agencies recommend this vaccine for routine travel in Asia. In Nepal, we recommend the vaccine only for foreign workers living in rural areas of the Terai. Casual visitors to the Terai probably do not need the vaccine. The main disease season in Nepal is August and September, a time when few foreign tourists visit the Terai. There has not been a single case of Japanese B Encephalitis in a foreigner in Nepal so far.

**Japanese B Encephalitis Vaccine:** The vaccine consists of killed virus, injected intramuscularly. The full series, for prospective residents of an endemic area, is 3 shots given on day 0, 7, and 28. If time is short, the 3 shots can be given one week apart. One

should have a booster at one year, and then every 3 years after that if you remain at risk. Casual tourists can get a slightly less degree of protection with two shots one week apart.

### **For the prevention of rabies encephalitis:**

Rabies is a virus transmitted by the bite of infected mammals. The disease is a risk in dog populations throughout the developing world, and in urban monkeys in India and Nepal. However, almost any mammal could theoretically carry and transmit the disease, including cows and horses. Most people are potentially infected by dog bites or monkey bites. The rabies virus, once injected by a bite, travels along peripheral nerves to the brain over a period of weeks to years, causing a fatal encephalitis. Because of the delay between the bite and clinical illness, rabies vaccine and anti-rabies serum can be injected after a bite to prevent the person from developing a rabies infection. This **post-exposure** series offers essentially 100% protection, with minimum side-effects. However, it takes a month to complete the five shots plus the initial injection of human rabies immune globulin (HRIG), which is a very expensive substance (\$400 to \$600 depending on your body weight). For this reason, long-term travelers or foreign residents often take a **pre-exposure series**, consisting of 3 shots on days 0, 7 days later, and either 21 or 28 days after the first shot. We recommend a booster after one year, and every three years after that. People who have completed the first 3 shots are considered pre-immunized against rabies, and if they are subsequently bitten by a suspicious animal, they require only two more boosters, 3 days apart. They avoid the expense of the HRIG, and the nuisance of having to get 5 shots over a one month period. Our studies suggested that a foreigner in Nepal has only a 1 in 6000 chance of acquiring a bite requiring rabies injections. The decision as to whether to take a pre-exposure series is up to the individual. However, we highly recommend the pre-exposure series for children, who may not report to their parents every contact with a stray animal or someone's pet. There are currently seven rabies vaccines licensed internationally.

**Tissue Culture Rabies Vaccines:** Rabies virus is cultivated on a number of different cell culture lines. All tissue culture rabies vaccines are considered acceptable for pre- or post-exposure use.

**1. Human Diploid Cell Vaccine (HDCV):** Currently the gold standard by which other vaccines are judged. Highly purified and highly immunogenic, with few side-effects in an initial series. There is a 5% risk of mild to moderate allergic reactions with later boosters.

**2. Purified Vero Cell Rabies Vaccine (PVRV):** Similar to HDCV, but grown on easier to handle monkey kidney cell lines. Antigenicity is high, the dose is half that of HDCV for the same effect. Because it is easier to manufacture, it is considerably less expensive than HDCV, and is available in many developing countries. It is the vaccine of choice at the CIWEC Clinic.

**3. Rabies Vaccine Absorbed:** Recently licensed as a second rabies vaccines in the United States (after HDCV). Essentially equivalent to HDCV.

**4. Purified Chick Embryo Vaccine (PCEV):** A tissue culture vaccine that is as antigenic as HDCV. Potential for side-effects in people allergic to eggs. Inexpensive and often widely available in developing countries. Can be used in emergencies. As with all third world vaccines, proper storage and handling need to be verified in order to completely rely on a given vaccine.

**5. Purified Duck Embryo Vaccine:** Similar to PCEV. An acceptable tissue culture vaccine, highly purified and highly antigenic. Should not to be confused with an earlier rabies vaccine, no longer manufactured, which was grown on duck embryos.

**Non-tissue culture rabies vaccines:** These older vaccines are highly contaminated with animal brain tissue, with a consequent high degree of side effects and allergic reactions. They requires up to 14 daily injections in the subcutaneous tissue of the abdomen. Immunologic efficacy is very low. Still in use in many developing countries; they should be avoided by tourists if the person has any chance of reaching reliable vaccines within a week or so.

**6. Neurotissue Rabies Vaccine (Semple Vaccine):** To be avoided, if possible.

**7. Suckling Mouse Brain Rabies Vaccine:** To be avoided, if possible.

**Human Rabies Immune Globulin (HRIG):** A highly purified antibody fraction obtained from the blood of immunized humans. Adverse reactions are extremely rare. Indicated in any significant rabies exposure, it is difficult to obtain in most developing countries due to expense.

**Equine Rabies Immune Globulin:** Rabies antibodies obtained from horse serum. Initially felt to be a high risk for allergic reactions, but experience in Thailand found that significant allergic reactions occurred in about 1 in 40 people. Could be an acceptable alternative in a severe exposure where HRIG was not available.

**For the prevention of cholera:**

Cholera is a severe form of diarrhea caused by a bacteria called *Vibrio Cholerae*. The bacteria produces toxins that can cause severe watery diarrhea that can lead to death in some people. However, cholera infection in most tourists is extremely rare and is associated with mild diarrhea, indistinguishable clinically from other travel-related diarrheas. The original whole-cell killed injectable vaccine had low efficacy and high side-effects and is not recommended any longer. Proof of cholera vaccination is no longer a requirement for entry into any country in the world. For workers or travelers heading into an area of high risk, an oral cholera vaccine has recently been marketed which should offer better protection with fewer side-effects.

**Live Oral Cholera Vaccine (Orochol Berna):** A single dose sachet, reconstituted in cold or lukewarm water along with a buffer. Side effects have been minimal. Protective efficacy appears to be high.

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Saturday, August 12, 1995

**OPERATING A TRAVEL  
MEDICINE CLINIC**

*Elaine Jong, MD*

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**Second World Congress on Wilderness Medicine.  
Session 58.**

**Operating a Travel Medicine Clinic:  
Development of a Business Plan**

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*Long range planning, identification of overall goals, projecting future conditions, critical analysis of resources, master plan for reaching goals:*

**I. Background and Business Description**

1. What is travel medicine?
2. Projected need for travel medicine in the next 5 years
3. Future trends:
  - Tourism-- adventure travel, ecotourism, luxury tours
  - Study abroad
  - Multinational corporations
  - Military
  - Volunteer, relief, and missionary organizations
  - Immigrants and refugees
  - Public health resources and recommendations
  - Reimbursement and regulatory environment

**II. Overall Strategy: Program development**

1. Why do you want to start a travel medicine clinic?  
(Reasons for getting into the business)
2. What relevant experience can you bring to the new activity?
3. What are the long range goals?

**III. Market Analysis**

1. Needs assessment:
  - Who are the potential customers?
  - What services do they need?
  - How accessible is the proposed location to the potential customers?

2. Market size:
  - Population and characteristics (age, education, occupation, median family income)
  - What services are covered by their health or insurance plan?
  - What services are they willing to pay for?
  - Where do they live and work?
3. Competitive analysis-- evaluate the competition:
  - Are similar services already available in the community?
  - What is their volume of business and estimated market share?
  - What is the availability of appointments (wait time)?
  - Are the needs of the consumers being met? (Customer satisfaction)

#### IV. Operational Analysis

1. Space and Facilities
  - Reception and waiting area
  - Office(s)
  - Examination room(s)
  - Storage: biologicals, clinical materials, forms, patient records, educational materials, references, teaching aids
2. Staffing needs
  - Telephone calls
  - Reception/Appointments
  - Pre-travel consultations
    - Advice
    - Prescriptions
    - Injections
    - Physical examinations
    - Authorized signature for health documents
  - Post-travel consultations
3. Ancillary Services
  - Registration and Medical Records
  - Billing and accounting services
  - Clinical laboratory services- on site or referral
  - Radiology services- on site or referral
  - Pharmacy services- on site or referral
  - Secretarial services
4. Days and hours of operation
  - Appointment schedules
  - Provision for medical care coverage in case of emergencies
5. Capital equipment
  - Telephone equipment
  - Commercial refrigerator with lock, emergency electrical supply
  - Computer and software
  - Reception/ waiting room furniture
  - Exam room equipment and furniture
  - Office furniture
  - Clinic sign

## **V. Financial Analysis**

1. What are the start-up costs?
  - Market research
  - Legal consultant
  - Financial consultant
  - Lease/rental deposits
  - Capital improvements to space
  - Office and clinic furniture
  - Office and clinic equipment
2. What is the operating budget per month?
  - Fixed expenses (indirect costs)
    - Rent
    - Utilities
    - Telephone service
    - Custodial service
    - Liability insurance
  - Semi-variable expenses
    - Staff salaries and benefits
    - Registration and Medical Records
    - Billing and accounting service
    - Laundry service
  - Variable expenses
    - Medical and office supplies
    - Photocopying
    - Long distance telephone and fax
    - Continuing medical education
3. Fee schedule and projected revenues from fees:
  - How many patients will you need to see each day to break even?
  - Pre-travel patients
  - Post-travel patients
4. Ancillary revenue
  - Donations
  - Fees for provision of customized information and services
  - Revenue from commercial sales
  - Clinical trials
  - Clinical training tuition

## **VI. Marketing Plan**

1. How will services be marketed to potential customers and colleagues?
  - Professional networks
  - Advertisements
  - Referrals from travel agents
  - Lectures in medical community
  - Lectures, interviews, articles for targeted customer audiences
  - Word of mouth from satisfied customers



2. What characteristics of the new clinic can be advertised and promoted?  
Can the needs of of the customers be met in an improved way?  
(quality, cost, service, convenience)  
What services and features will make the new clinic unique?
3. Pricing strategy  
Reimbursement  
Competitive  
Cost plus  
Return on investment
4. Access to service  
Information process  
Appointment process  
Transportation directions  
Parking  
Hours of operation

## VII. Work Plan: Implementation

1. Receptionist  
Answers incoming telephone calls  
Schedules appointments  
Greets customers arriving for appts.  
Coordinates Registration and Medical Records  
Coordinates health documents and lab results for clinician review and processing  
Secretarial services
2. Medical Director(s) & Travel Nurse Manager:  
Policy and Procedures  
Program administration  
Selects telephone/ voice mail system  
Selects computer and software  
Orders, stocks, and monitors:  
Vaccines and biologicals  
Immunization supplies  
Vaccine Consent Forms  
Vaccine Record Forms  
Medical Record Forms  
Intl. Certificates of Vaccination  
Official stamps  
Creates brochures and information sheets  
Selects reference books, journals, newsletters, and bulletins for updated  
information library  
Organizes files for information, resources, reference articles  
Responds to requests for information  
Reviews Accounts and Billing procedures  
Reviews monthly budget  
Coordinates staff schedule  
Serves as liason with other parts of the clinical practice group  
Participates in quality improvement activities

3. Pre-travel advisor (Physician or Travel Medicine Nurse)
  - Gives travel health advice based on risk assessment
  - Orders immunizations
  - Orders tests for immune status
  - Writes prescriptions for travel medications (signed by MD)
4. Immunization Nurse
  - Verifies immunization schedules, vaccine consent forms, vaccine waivers
  - Gives injections
  - Records immunizations (date, vaccine name, lot number, dose, injection route, injection site) in medical record, vaccine log, and International Certificates of Vaccination
  - Reminds patient of what to do for unexpected adverse reactions to vaccines
  - Encourages patient's compliance with travel medicine advice
  - Participates in quality improvement activities
5. Physician or Health Care Specialist
  - Performs pre-travel physical exams
  - Orders diagnostic tests as required
  - Qualifies travelers for overseas assignments
  - Participates in quality improvement activities
6. Physician Consultant(s)
  - Provides pre-travel advice for travelers with special health concerns
  - Signs and notarizes official health documents
  - Provides post-travel diagnosis and treatment
  - Participates in quality improvement activities

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## Resources and References

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### HEALTH INFORMATION FOR INTERNATIONAL TRAVEL 1994

*(revised on an annual basis)*

U.S. Department of Health and Human Services  
Public Health Service  
Centers for Disease Control  
Atlanta, Georgia 30333

For sale by: Superintendent of Documents  
U.S. Government Printing Office  
Washington, D.C. 20402  
(202) 783-3238

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### SUMMARY OF HEALTH INFORMATION FOR INTERNATIONAL TRAVEL

*("The Blue Sheet" is published biweekly)*

Lists countries with areas infected with quarantinable diseases according to the W.H.O.

U.S. Department of Health and Human Services  
Public Health Service  
Centers for Disease Control and Prevention (CDC)  
Atlanta, Georgia 30333

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*All immunizations given prior to travel should be recorded in the:*  
INTERNATIONAL CERTIFICATES OF VACCINATION  
U.S. Department of Health and Human Services Public Health Service (PHS-731)  
as approved by the WORLD HEALTH ORGANIZATION

Source: Superintendent of Documents  
U.S. Government Printing Office  
Washington, D.C. 20402  
(202) 783-323

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**TELEPHONE INFORMATION, HOTLINES, AUDIO LIBRARIES**

Centers for Disease Control and Prevention  
Traveler's Health Hotline

(404) 332-4559

Centers for Disease Control and Prevention  
FAX Information Number

(404) 332-4565

United States Department of State  
Citizen's Emergency Center

(202) 647-5225

University of Washington Medical Center  
Travel Medicine Service Audio Library

(206) 548-4888

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**TEXTBOOKS AND GENERAL REFERENCES:**

Bia, F (ed): The Travel Medicine Advisor and The Travel Medicine Update, Atlanta, American Health Consultants, 1993- present.

Gardner P (ed): Infectious Diseases in International Travelers, Infectious Disease Clinics of North America, vol.6, June, 1992.

Jong EC, McMullen R (eds): The Travel and Tropical Medicine Manual, 2nd edition. Philadelphia, WB Saunders. 1995.

Jong EC, Keystone J, McMullen R, (eds): The Travel Medicine Advisor and The Travel Medicine Update, Atlanta, American Health Consultants, 1991-93.

Wilson ME: A World Guide to Infections, New York, Oxford University Press, 1991.

Wolfe MS (ed): Health Hints for the Tropics, ed.11, American Society of Tropical Medicine and Hygiene, 1993 (new edition scheduled for late 1995).

Wolfe MS (ed): Travel Medicine, Medical Clinics of North America, vol.76, November, 1992.

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**BULLETINS AND NEWSLETTERS:**

International Association for Medical Assistance to Travellers Directory of English-Speaking Physicians (revised periodically): IAMAT, 40 Regal Road, Guelph, Ontario, N1K 1B5 [TEL (519) 836-0102; FAX (519) 836-3412]

International Association for Medical Assistance to Travellers World Malaria Risk Chart 1995 (revised annually): IAMAT, 40 Regal Road, Guelph, Ontario, N1K 1B5 [TEL (519) 836-0102; FAX (519) 836-3412]

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Saturday, August 12, 1995

# **IMPROVISED TECHNIQUES IN MOUNTAIN RESCUE**

*Bill Clem, MD & Ken Zafren, MD*

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# IMPROVISED TECHNIQUES IN MOUNTAIN RESCUE

Ken Zafren, MD and Bill Clem, MD

## OBJECTIVES

Following this presentation, participants will be able to:

1. anticipate rescue situations for which optimal equipment may not be available in a timely fashion.
2. manage those situations effectively.
3. more effectively function as members or advisors of search and rescue groups.

Note: Although participants will learn some specific knots and techniques, they should not expect to master them in a single workshop. We will emphasize the process of improvisation rather than specific techniques.

Some basic rescue techniques:

Improvised harnesses (especially Duffer seat, Parisian baudrier, and full body harness)

Tragsitz

Tension release devices (TRDs)

Friction knots and self-minding soft cams (especially modified French "Prusik")

Methods of ascending a fixed rope

Load-raising and mechanical advantage

Improvised brakes

Improvised stretchers and carries

Improvised anchors (rock, snow and ice)

Equalizing anchors

Improvised splinting and traction

Further reading (annotated by Ken Zafren, MD):

March B *Improvised techniques in mountain rescue* The Jacobean Press, Ltd. no year given. The only book I know which is devoted wholly to this subject, it is an excellent overview but may be hard to find.

May WG *Mountain Search and Rescue Techniques* Rocky Mountain Rescue Group 1973. This was the "bible" during my years with RMRG and contains a lot of material on improvisation. It is inexpensive, easy to obtain and comprehensive, even if a bit dated. All of the techniques have been extensively tested by RMRG.

Setnicka TJ *Wilderness Search and Rescue* Appalachian Mountain Club 1980. this is another "bible" for mountain rescue. It is widely available although somewhat dated. Setnicka's book is more encyclopedic than May's book, but at the cost of being less a unified set of techniques that have been tested by a single group.

Weiss EA and Donner HJ *Wilderness Improvisation* In Auerbach PS *Wilderness Medicine: Management of Wilderness and Environmental Emergencies (Third Edition)* Mosby 1995. The emphasis in this chapter is on medical care and victim transport. Techniques are well illustrated and 22 uses are given for a safety pin.

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Saturday, August 12, 1995

**COLD WATER  
NEAR DROWNING**

*Eric A. Weiss, MD*

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# COLD WATER IMMERSION AND NEAR DROWNING

Eric A. Weiss, MD  
Assistant Professor, Department Of Surgery  
And Emergency Medicine  
Associate Director Of Trauma  
Stanford University Medical Center

## OBJECTIVES:

- 1) UNDERSTAND THE PATHOPHYSIOLOGY OF COLD WATER INDUCED REFLEXES WHICH PRODUCE SUBMERSION INCIDENTS.
- 2) UNDERSTAND THE PATHOPHYSIOLOGY AND EMERGENCY TREATMENT OF ACUTE SUBMERSION INCIDENTS.
- 3) REVIEW THE LITERATURE ON COLD WATER NEAR DROWNINGS AND EXPLAIN THE REASONS FOR SURVIVAL AFTER PROLONGED SUBMERSION.

## Introduction

Water makes up about 72% of the earth's surface. It is not surprising that water related accidents contribute substantially to the growing number of accidental deaths and injuries that are occurring each year. Drowning is now the second most common cause of accidental deaths among children and the third leading cause of death in young adults. It is clear that this environmental hazard embodies jarring social and medical ramifications. The tragedy of drowning is compounded by the age population of the majority of its victims. Children under 5 years of age account for 50% of the fatalities in the United States while 60-70% of all drownings occur in those under 20 years of age.

These statistics emphasize the necessity for adequate preventative measures such as: constructing physical barriers around swimming pools and keeping the water level in the pool near the edge so that a child having fallen in would have the potential to climb out. Having trained lifeguards and keeping pools covered when not in use are other important considerations, which would not require exorbitant resources.

This discussion will introduce other preventive measures, which go beyond those mentioned above. First I will define some terms related to the topic of near drowning. The discussion to follow will cover the Epidemiology, Pathophysiology of Drowning, and lastly, First Aid and Hospital Management of the near-drowned.



## I. DEFINITIONS

- A. Drowning: Death by suffocation after submersion in a liquid.
- B. Near Drowning: Survival for at least 24 hours after a submersion episode. If the patient subsequently dies of complications after 24 hours (due to pneumonia, A.R.D.S., renal failure, cerebral edema, etc.) the cause of death is attributed to the complications and is referred to as secondary to near drowning.
- C. Secondary Drowning: Refers to the pulmonary complications manifest in the Adult Respiratory Distress Syndrome (A.R.D.S.), often seen after submersion incidents.
- D. Submersion Incident: Preferred nomenclature for drowning and near drowning events as it encompasses both the terms near drowning and drowning without the implication of time or prognosis.
- E. Wet Drowning: Aspiration of water into the lungs with resultant pulmonary damage. This occurs in approximately 85 to 90% of victims.
- F. Dry Drowning: No significant aspiration of water into the lungs. This occurs in approximately 10 to 15% of victims.
- G. Mammalian Dive Reflex (MDR): Slowing of the heart and shunting of blood to the brain initiated when cold water suddenly comes into contact with receptors in the back of the nose. Same mechanism which permits whales, seals and other aquatic mammals to hunt for long periods under water. Significant effect in man debated.
- H. Immersion Syndrome: Cardiac arrest (ventricular fibrillation) secondary to sudden immersion in very cold water. Thought to be due to massive vagal stimulation.
- I. Cold Water Drowning: Submersion in water less than 10 degrees Centigrade.
- J. Acute Submersion Hypothermia: The rapid development of hypothermia during fresh water drowning due to "core" cooling from pulmonary aspiration and rapid absorption of fresh cold water.

II. EPIDEMIOLOGY: It is difficult to estimate accurately the yearly world incidence of submersion accidents since two of the largest and most densely populated countries, China and the Soviet Union, do not submit statistics to the World Health Organization. At present, it is estimated that there are more than 150,000 annual deaths worldwide and over 8,000 deaths each year in the United States. These statistics underestimate the problem since many deaths go unreported or are attributed to other causes. The world fatality rate is approximately 6 deaths per 100,000 persons. For every drowning, there are at least 5 hospital admissions for near drowning accidents.

### III. RISK FACTORS

- A. Age: 40 to 50% of submersion incidents occur in the age group of 0 to 4, with the highest rate among ages 1 to 2. Teenage boys constitute the other highest risk group for reasons that are only speculative: adventuresome nature; peer pressure; mobility; less adult supervision.
- B. Location: Region - Rates for drowning are generally highest in the southern and western states, except Alaska, which has the highest rate; Medium - Fresh water is the primary media (98%) in submersion accidents; Place - Private swimming pools account for 50% of submersion incidents, except in the southeast, where lakes, rivers and streams predominate. In recent years, residential spa and hot tub use has markedly increased, resulting in an estimated 1,100 persons requiring emergency room treatment in 1981 as compared with a mere 200 the previous year. Because of elevated temperatures of hot tubs, anoxic brain damage is likely to occur more rapidly than in cold water drownings. The presence of Pseudomonas aeruginosa in tub water increases the risk of Pseudomonas pneumonia in victims who inhale this water during submersion.
- C. Alcohol - The contribution of alcohol in submersion incidents is an obvious association. An Australian study in 1979 documented that 64% of all adult males who drowned had markedly elevated blood alcohol levels.

D. Boating Accidents: Thirty percent of adult drownings are attributable to boating accidents, the single most important factor being poor judgement, e.g., leaving one's life jacket at home.

E. Pre-existing Illness: The risk of submersion incidents is higher among groups of individuals with pre-existing medical illnesses such as diabetes and epilepsy.

IV. PATHOPHYSIOLOGY: From studies in both animals and humans, the response to submersion has been divided by some researches into the following stages:

- Stage I - The aspiration of small amounts of water produces laryngospasm (up to 2 minutes);

- Stage II - Swallowing of water into the stomach;

- Stage III

- (A) Approximately 10 to 15 percent of victims have continued laryngospasm and aspirate no further detectable water (dry drowning). Death occurs secondary to anoxia.

- (B) 80 to 90% have relaxation of laryngo spasm from severe hypoxemia and hypercapnia with further aspiration of water (less than 10 cc per kg); Stage IV - Agonal respirations.

A. Salt Versus Fresh Water Immersion:

1. Serum Electrolytes: At one time, it was believed that important pathophysiological differences existed between drowning in fresh or salt water. This was largely due to experiments with animals who aspirated much larger quantities of fluid. Subsequent experiments in dogs, with confirmation in humans, showed that changes in volume states and electrolytes rarely occurred regardless of the drowning medium. Humans rarely aspirate more than 10 cc per kg and in animal studies 22 cc per kg of aspirated water was required before significant electrolyte changes occurred. An exception to this, however, was observed in victims suffering submersion incidents in the Dead Sea. Due to the much higher concentration of electrolytes in this body of water, significant serum electrolyte changes did occur.

B. Pulmonary Manifestations: Although fresh and salt water do exert different effects on the lung, the end result of aspiration is largely the same. Profound hypoxemia develops secondary to reduced ventilation to perfusion ratios with intrapulmonic shunting. Sea water is three to four times the osmolality of blood and "draws" fluid from the plasma into the alveoli, resulting in a intrapulmonic shunt. With fresh water aspiration, the hypotonic fluid is absorbed rapidly into the circulation across the permeable alveolar pneumocytes and quickly redistributed and excreted. In experimental animals, even when the quantity of water is large, an increase in blood volume is no longer seen after 60 minutes. Hypotonic water exerts its deleterious effects through alteration in the surface tension properties of pulmonary surfactant, resulting in decreased lung compliance, atelectasis and resultant shunting. A recent study by Orlowski in Critical Care Medicine, February, 1987, addressed the issue of whether altering tonicity of drowning fluids might reduce pulmonary injury and thus improve survival rates of patients. Sterile water was found to be much more injurious than salt water (3% NaCl) or normal saline (.9%). The least damaging fluid appeared to be .225% and .45% NaCl solution. It was hypothesized that .225% and .45% NaCl solutions moved from the alveoli into the vascular system quickly, without destroying surfactant. More hypertonic solutions stay in the alveoli longer, impeding gas exchange. It is estimated that it would cost \$60.00 to convert an average swimming pool to .225% NaCl. However, the effects on the metallic pipes, pumps and fittings have not been determined. Whether any of this improves survival has yet to be proven.

V. MANAGEMENT:

I. First Aid: The Gold Standard is still immediate and aggressive initiation of ventilation and oxygenation. Evidence of trauma should be noted and attention given to cervical spine precautions. Contributing and associating factors such as hypoglycemia, seizures,

and hypothermia need to be considered. Because apnea usually precedes cardiac arrest if ventilation is provided, circulatory resumption may occur spontaneously. Supplemental oxygen should be provided as soon as possible.

The Heimlich maneuver has been recommended by the American Red Cross and American Heart Association as a method for saving submersion victims in the past. More recently, this technique has been negatively criticized in the literature and abandoned by many experts. This maneuver is not recommended unless a clear airway cannot be obtained by other means or there is no response to ventilation because of an obstructed airway. Arguments for not performing the Heimlich maneuver include:

- (1) Substantial risk of gastric contents aspiration into the lungs, since submersion victims frequently swallow large amounts of water.
- (2) Gastric emptying may slow the initiation of mouth to mouth ventilation or deter a rescuer from initiating it.
- (3) Many victims aspirate only small amounts of water, which is rapidly absorbed from the lungs into the circulation.

B. Hospital Management: Correcting intrapulmonary shunting by application of continuous positive airway pressure has been shown to increase arterial oxygen tension and is generally accepted as a therapeutic modality. During the past 5 years, considerable attention to "cerebral resuscitation" has led to therapies which are still controversial, requiring further study. Use of dehydration, controlled hypothermia, barbiturate coma, prophylactic antibiotics and corticosteroids are still being evaluated, but at present have not been shown to be of significant benefit. Despite the controversy over Intensive Care management, it is generally agreed that the prognosis for cerebral recovery depends more on the effective initiation of early resuscitation at the scene, rather than the quality of subsequent hospital care.

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**Saturday, August 12, 1995**

**AIR MEDICAL  
EVACUATIONS**

*William Casey*

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## **Air Medical Evacuations**

**William D. Casey  
Phoenix Alliance, Inc.  
Chairman, President & CEO  
St. Paul, Minnesota**

**Following this presentation, participants will be able to; conduct, actively participate, or have a resource available to implement medical repatriation.**

**The following are key issues that will be addressed:**

- 1. Understand major issues to be managed in medical repatriation**
- 2. The detailed information necessary to make arrangements for repatriation**
- 3. Identify the stakeholders and involvement in the evacuation**
- 4. Identify the interpersonal skills necessary to efficiently implement repatriation**
- 5. Discuss use of intermediate medical facilities**
- 6. Identify situations which require services of air ambulance**
- 7. Evaluate commercial - vs - dedicated carrier use**
- 8. Identify key factors in selecting an air ambulance carrier**
- 9. Identify areas to consider as part of pre-planning for medical repatriation**

## **1. Understand major issues to be managed in medical repatriation**

Primarily two issues:

- complete communications across different time zones and languages, with people who have rarely been confronted by the need for evacuation; and,
- coordination of services and schedules

Four major stakeholders need to participate in the communication and coordination along with the patient:

- Insurer or those financing the care and transportation
- Transportation providers
- Medical experts - with the patient, air transportation specialists and those who will receive the patient
- Family

## **2. The detailed information necessary to make arrangements for repatriation**

1. Clear understanding of patient needs - short and long term
2. Detail the objective to achieve through the evacuation
3. Time constraints
4. Equipment requirements given patient needs
5. Provide specifics to the stakeholders so that financial arrangements can be confirmed.



### **3. Identify the stakeholders and involvement in the evacuation**

Clearly communicate the objective of the evacuation to all stakeholders and support systems.

- Patient
- Local medical experts
- Family
- Insurer/financing agent
- Air carrier
- Receiving medical facility
- Coordination role - who is it?

### **4. Identify the interpersonal skills necessary to efficiently implement repatriation**

- diplomacy
- sales - "making the mission clear"

### **5. Discuss use of intermediate medical facilities**

As an alternative to transporting a patient to their home location, use of quality medical facilities in an intermediate location can be cost effective and provide excellent patient care. On occasions, this may be required by the insurer/payor.

### **6. Identify situations which require services of air ambulance**

Dedicated medical air ambulance use is warranted based on two factors:

- patient's care during transportation needs to replicate the skilled/hospital level services being delivered
- hassle and expense factors given other alternative care and transportation solutions

## **7. Evaluate commercial - vs - dedicated carrier use**

Commercial carriers can often duplicate the services of a dedicated carrier. Assuming that patient need does not clearly dictate the use of a dedicated carrier, commercial lines should be evaluated.

Key contact to make arrangements is the carrier's medical director or advisor. During scheduled stops and lay-overs, additional care services can be arranged.

## **8. Identify key factors in selecting an air ambulance carrier**

Do not assume that the geographic location of a carrier is the major selection factor. Many carriers have global experience and, regardless of their home base, can successfully complete missions anywhere.

## **9. Identify areas to consider as part of pre-planning for medical repatriation**

Best tactic is to always assume a repatriation will need to occur.

Create a written plan with list of resources to contact. Keep the plan with travel papers/passport.

- knowledge of insurance coverage available and contacts
- identified local physician, hospital, transportation resources
- understand what services can and cannot be delivered by local resources
- potential air carriers/transportation solutions
- how to access and forward medical records
- knowledge of local culture and customs
- family contacts

# PHOENIX ALLIANCE, INC.

## MEDICAL CREDO

WE, THE MEMBERS OF PHOENIX ALLIANCE,  
SHARE THESE FUNDAMENTAL BELIEFS:

- THAT appropriate, high quality medical care is a valued asset in modern society and, at times, an important determinant of the continuing function of an individual.
- THAT certain physicians and medical centers are outstanding in their respective specialty fields and in the delivery of patient care.
- THAT a reputation for excellence is acquired through achievements in clinical practice, research, and education which are the cornerstones for the delivery of the highest quality medical care.
- THAT it is possible to identify these national and international clinical leaders in medicine by consulting among a network of currently recognized medical authorities.
- THAT advances in technology and transportation make it possible to establish linkages and provide access to the world's superior physicians and medical institutions into an international healthcare network without walls, which offers excellence, convenience, and rapid response.
- THAT any individual, particularly when away from home, may have difficulty identifying and accessing the highest levels of quality medical care.
- THAT this difficulty is not the fault of patients, payors, physicians, or government but rather results from the inherently fragmented nature of medical care as it is presently organized and practiced.
- THAT the patient is a human being with human frailties and fears, and that timely service, with a caring and compassionate attitude is essential for the highest quality medical care.

*Phoenix Alliance has been created to provide  
for individuals and Corporations  
an opportunity to maximize for themselves and their employees  
the potential of excellent clinical medicine.*

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Saturday, August 12, 1995

# DIARRHEAL ILLNESS

*David Shlim, MD*

## DIARRHEAL ILLNESS

David R. Shlim, M.D.  
Medical Director, The CIWEC Clinic  
Kathmandu, Nepal

Learning Objectives: Following this presentation, participants will be able to:

1. Understand the epidemiology and etiology of travelers' diarrhea.
2. Take a clinical history and make a presumptive diagnosis in travelers' diarrhea.
3. Recommend appropriate treatments for specific causes of travelers' diarrhea.

Travelers' diarrhea is not a single entity. Not only is the etiology wide-ranging, encompassing toxins, bacteria, viruses, and several protozoa, but the symptoms themselves have a wide spectrum. Travelers' diarrhea is often dismissed in textbooks as a mild, self-limiting disorder, for which no specific treatment is required. When antibiotic treatment is discussed, the hazards of the treatment are often emphasized out of proportion to their benefit: lack of efficacy, prolongation of the carrier state, breeding of resistant strains, and adverse reactions to the drugs. No one stresses how miserable one can be with diarrhea, or how severely it can interrupt carefully made travel plans, or even jeopardize the success of an expedition that has been planned for years. Part of the problem is that few doctors have direct experience treating travelers diarrhea in large numbers. I will discuss my view of travelers diarrhea based on 12 years experience at the CIWEC Clinic, with more than 20,000 people who presented with diarrhea.

### I. Epidemiology

Travelers' diarrhea is simply infectious diarrhea, acquired while traveling, usually because standards of public health and hygiene in developing countries are minimal to non-existent. The organisms that cause diarrhea are passed in stool, and are acquired from eating or drinking contaminated food or water. How does this happen? Or perhaps one should ask, why doesn't this happen in developed countries?

The major breakthrough in public health in developed countries was the ability to isolate fecal material from the general environment. This is accomplished in most countries by elaborate sewage mechanisms, in which stool is immediately flushed away

down toilets, only to emerge many miles away in treatment facilities, far from human kitchens. In developing countries, most people have to find a place to defecate outside, where the stool remains open to the environment, able to be washed into water supplies, or carried on feet into houses, or carried by houseflies into kitchens. Wherever there is abundant stool in the environment, it will find a way into your mouth.

The major advice given to travelers to help avoid eating stool, usually condensed as "boil it, peel it, or forget it," is useful, but insufficient to avoid eating contaminated food. Kitchens in most third world restaurants do not follow basic standards of hygiene, so that cooked foods are placed where raw meat was processed, flies gain free entry, hands are not washed regularly, food is stored at improper temperatures, and equipment is not cleaned regularly. Almost any item of food can become randomly contaminated through these errors, and eating in restaurants becomes a kind of Russian roulette. In this scenario, the highest risk foods would not be salads or drinking water, but dishes that are prepared earlier in the day, and then served later, such as lasagna, quiche, and casseroles. Travelers should avoid these items unless they are served extremely hot.

Travelers' diarrhea is usually reported in about 30% of travelers in the first two weeks of travel in most third world countries. Incidence figures are not available for travelers in Nepal, but in a recent survey conducted among resident expatriates who had been living in Nepal for less than two years, 50% reported a diarrheal illness in the past month, and the average number of diarrheal episodes per year was 6. Thus, roughly 100% of expatriates in Nepal had a diarrheal episode every 2 months.

## II. Etiology

Diarrhea in travelers can be caused by toxins, viruses, bacteria, or protozoa. The toxins are waste-products of certain bacteria that can grow on food, and once ingested cause severe gastroenteritis symptoms for 6-12 hours. No infection takes place in the intestine, and treatment can only be supportive. Viruses can cause vomiting and diarrhea, or either one alone. In Nepal, viruses are present in about 5% of stool samples. Bacteria are the major cause of diarrhea in travelers in Nepal, accounting for about 85% of diarrhea cases clinically. This category encompasses enterotoxigenic *E. Coli*, *Shigella*, *Campylobacter*, and *Salmonella*, in decreasing order of frequency. The major protozoa are *Giardia lamblia*, *Entamoeba histolytica*, and the Coccidia-like body (CLB), which is now referred to as *Cyclospora*. *Dientamoeba fragilis*, and *Cryptosporidium* are infrequent causes of diarrhea in Nepal. *Blastocystis hominis* is found in 30% of all stool samples in Nepal, but its role as a pathogen has not been established. We recently completed a prospective case-control study which showed that *B hominis* was not present more often in people with diarrhea than in non-diarrhea controls. We ignore *B hominis* as a stool finding in the CIWEC Clinic.

Given all these organisms, how can a traveling doctor make a diagnosis and offer treatment to a fellow traveler? We have found it useful to divide the above organisms into two categories: *treatable* and *untreatable*. The clinical spectrum thus appears as follows:

CAUSES OF DIARRHEA IN TRAVELERS	
TREATABLE	UNTREATABLE
1. All Pathogenic Bacteria	1. Toxins
2. <i>G lamblia</i>	2. Viruses
3. <i>E histolytica</i>	3. <i>Cryptosporidium</i>
4. <i>Cyclospora</i>	
5. <i>D fragilis</i>	

Since the purpose of making a diagnosis is to be able to offer treatment, it makes sense to focus on the clinical presentation of treatable causes of diarrhea. Overall, about 90-95% of our patients present with a treatable cause of diarrhea. In the CIWEC Clinic, the breakdown of treatable causes of diarrhea is roughly:

Pathogenic Bacteria	(85%)
<i>G lamblia</i>	(14%)
<i>E histolytica</i>	( 1%)

*Dientamoeba fragilis* is quite uncommon, difficult to diagnose with certainty, and accounts for only a few cases of treatable diarrhea per year. *Cyclospora* is only present during the late spring and summer months. The 3 treatable causes of diarrhea can be further broken down into *bacterial* diarrhea and *protozoal* diarrhea. With only two syndromes to consider, it becomes easier to make an empiric diagnosis.

### III. Diagnosis

Too much emphasis has been placed on the stool exam in evaluating travelers' diarrhea. The stool exam in most developing countries is extremely unreliable, with overdiagnosis of protozoa the most common error. Even in a reliable lab, such as the CIWEC Clinic, the stool exam has limitations. The stool exam should be thought of as a highly specific, but not very sensitive test. Positive findings, such as white blood cells and protozoa can be reliably identified, but the absence of these findings is not very predictive that infections are not present. Specifically, we have shown that the presence of white blood cells in the stool is highly predictive of bacterial infection, but white blood cells are present in only 50% of bacterial diarrheal infections overall. In other words, a stool exam that is "negative" for white blood cells still has a 50% chance of growing out pathogenic bacteria on culture. The predictive value of negative exams for protozoa is even less, perhaps as low as 20%. Three negative exams for *E histolytica* is thought to represent only an 80% chance that the organism is not present.

Stool culture for bacterial pathogens takes at least 3 days to get results, and the most common pathogen, enterotoxigenic *E coli* can only be demonstrated in highly sophisticated laboratories. Each pathogenic organism requires special plates and identification, making routine stool cultures an expensive and tedious process. Most third

world laboratories can only culture for a few organisms. Treatment decisions are usually made before the results of culture would be available. Viral pathogens can only be sought using specific test kits that are not usually available in the field.

With no reliable diagnostic test to prove whether a specific pathogen is present or not, **the history of the present illness becomes the single most reliable tool for making a treatment decision.** The history should include how long the person has been traveling in an area of risk, previous diarrheal illnesses, and a careful history of the current illness. Since the incubation period of protozoal pathogens varies from 1-2 weeks, diarrhea in the first 1-2 weeks of travel is almost invariably bacterial. The following discussion will help distinguish between the two main treatable syndromes of travelers' diarrhea: bacterial diarrhea, and protozoal diarrhea.

**Bacterial diarrhea** is characterized by the *sudden* onset of relatively uncomfortable diarrhea. **Protozoal diarrhea** is characterized by the gradual onset of tolerable diarrhea. Although these two syndromes can overlap to some extent, this method of looking at the problem has proven extremely useful. Sudden onset means that the patient can usually report to you the precise time of day their illness began. They will also report that the diarrhea and associated symptoms were quite bothersome right from the start. In contrast, protozoal diarrhea usually begins with a few loose stools, making people wonder if they are getting sick. The symptoms might be 2-5 loose stools per day, but with mild cramping and urgency as the usual accompanying symptoms. They often wait 1-2 *weeks* before seeking treatment, whereas people with bacterial diarrhea will seek help within 1-2 *days*.

The sudden onset of relatively uncomfortable diarrhea is the *minimum* description of bacterial diarrhea. Additional specific symptoms can only add to the certainty of the diagnosis. Fever, vomiting, or blood in the stool can all be present, and are much more often associated with bacterial diarrhea than protozoal diarrhea. Food poisoning can present exactly like bacterial diarrhea. However, the difference is that by the time the person who has food poisoning is able to seek help (that is, strong enough to leave their rooms or the immediate vicinity of a toilet), they are usually on the way to recovering rapidly. People with bacterial diarrhea may have vomiting and fever in the first 12 hours of their illness, but these symptoms usually subside spontaneously, leaving diarrhea and cramps as the only persistent symptoms. The distinction between food poisoning with vomiting and bacterial diarrhea with vomiting is not critical to make in the first 12 hours, since vomiting usually precludes the giving of definitive antibiotics at this early stage. If all symptoms go away rapidly, no therapy is needed; if diarrhea persists, it is likely to be a form of bacterial diarrhea.

Viral gastroenteritis generally presents in a manner indistinguishable from bacterial diarrhea. However, since we know in Nepal that viruses are uncommon in comparison to pathogenic bacteria, we ignore them as pathogens. Since the odds are over 95% that the etiology will be bacterial rather than viral, why withhold treatment to avoid the overtreatment of a few cases of viral diarrhea?

Giardiasis presents as the gradual onset of rumbling gut, diarrhea and flatulence. Stools are often urgent, but not necessarily crampy. Epigastric pain can occur, but vomiting is rare. There is often a daily pattern of several loose stools in the morning, followed by a relatively normal day except for the occasional urgent bowel movement.



Amoebiasis accounts for only 1% of diarrhea in our patient population in Nepal. This is an important figure to remember, since the local laboratories diagnose amoebiasis in almost everyone who submits a sample. The reason for the overdiagnosis of *E histolytica* infection seems to be: 1) they mistake macrophages for amoebas (macrophages are frequently seen in severe bacterial infections), and 2) they call any amoeba that is encountered *E histolytica* (a number of other non-pathogenic amoebas are commonly encountered in stool exams). A person presenting with amoebiasis will often have several weeks of low-grade diarrhea, alternating every few days with either normal stool or constipation. Very rarely, a person with *E histolytica* will present with classic amoebic dysentery: frequent passage of small amounts of bloody, mucoid stool, associated with cramps and tenesmus. This classic form of amoebiasis is so rare in travelers in Nepal that we see about one case per year at most.

In 1989, the laboratory technician at the CIWEC Clinic noted a new particle in stool exams. I asked him to start recording it on the stool exams, and soon we realized that this particle was associated with a distinct syndrome of diarrhea, fatigue, and loss of appetite. Since then we have diagnosed over 500 cases, by far the largest series in the world. The organism was originally thought to be a new form of cyanobacteria (blue-green algae), but has recently been confirmed as a new coccidian, of the species *Cyclospora*. The organism infects the upper intestine, causing inflammation and flattening of the villi. The illness lasts from 2-12 weeks, averaging 6 weeks. In 1994, The CIWEC Clinic completed a double-blind, placebo-controlled trial using trimethoprim-sulfamethoxazole twice a day for 7 days in patients with *Cyclospora* diarrhea. The treatment was 94% effective at eliminating symptoms and eradicating the organism. The one patient who didn't respond in 7 days, was cured with additional trimethoprim-sulfamethoxazole therapy. The illness is a risk in Nepal only from the end of April through September, so most trekkers are not at risk. It has been shown to be waterborne, and iodine may not be sufficient to kill it.

*Cryptosporidium* is another coccidian parasite of the upper intestine. It is rare in Nepal, accounting for only a handful of cases per year. It causes a prolonged, low-grade diarrhea. It is self-limited, and no treatment is available at present.

*Dientamoeba fragilis* is actually a flagellate without a tail. It can cause low-grade symptoms for a number of weeks. Because it resembles an amoeba, and has no cyst form, making a definitive diagnosis is difficult. When diagnosed, it can be treated with tetracycline 250 mg QID for 10 days, with excellent results.

Despite isolated case reports of antibiotic-induced diarrhea in travelers, this entity must be extremely rare, since we have never suspected that we have seen it. Prospective careful screening might turn up a few cases, but in general it seems to be safe to ignore this entity even though travelers commonly use antibiotics.

#### IV. Antibiotic Treatment

The two syndromes of treatable diarrhea, bacterial and protozoal, expand into four syndromes in relation to treatment. Currently all pathogenic bacteria that can cause diarrhea are susceptible to the fluoroquinolones, usually norfloxacin or ciprofloxacin. Therefore, it is not necessary to make a specific etiologic diagnosis in order to recommend

treatment. The treatment for *G lamblia* differs from *E histolytica*, adding two more regimens. As mentioned above, *Cyclospora* is now treatable as well.

Bacterial diarrhea is almost always self-limiting, but the length of time can vary from a few hours to over two weeks. It is important to bear in mind that people with diarrhea don't want to have diarrhea. Now that effective treatment exists, it doesn't make sense to wait from 1-10 days to see if you are going to get better on your own. Antibiotic treatment with a quinolone antibiotic can shorten the illness to one day. Side-effects are extremely rare. A prolonged carrier state is not usually induced, and even if it were, what difference would that make? Antibiotic resistance will inevitably come, but as long as the use of the antibiotic is limited to travelers, resistance will be almost impossible to induce, against a background of hundreds of millions of people who are not using the drug.

The treatment for all bacterial diarrhea is either ciprofloxacin 500 mg BID, or norfloxacin 400 mg BID, for 3 days. Longer treatment is clearly not indicated, and shorter treatment may be effective in many people. Single dose treatment has been shown to be effective in a few clinical trials. I feel that the ideal length of treatment of bacterial diarrhea is somewhere between 1 and 6 pills. The advantage of the longer regimen in people who remain at constant risk (that is, anyone who is still in a developing country), is less chance of confusion if they get sick again within one or two days of treatment. Relapse is almost unheard of after 3 days of therapy. This point will be clarified in further studies in the next few years. There is little reason to choose between norfloxacin and ciprofloxacin; we prefer norfloxacin since it works very well, is less expensive, and may have slightly fewer side effects than ciprofloxacin.

Of recent concern is a report from Thailand of numerous isolates of *Campylobacter* species resistant to ciprofloxacin in U.S. army personnel. However, clinically the patients with resistant *Campylobacter* isolates got better just as quickly as people with sensitive organisms. Further studies should help clarify this emerging issue.

The best treatment for *G lamblia* is quinacrine 100 mg TID for 5-7 days. This drug is well-tolerated, works rapidly, and failure to cure is very rare. Unfortunately, it has become unavailable in the last year due to a problem in manufacturing. In North America, an alternative is metronidazole 250 mg TID for 7 days. Several years ago, a single dose of 2 grams of metronidazole was recommended for *G lamblia*, but this has been largely abandoned due to lack of efficacy (about 65% cure rate). Outside of North America, the drug tinidazole has been used to treat both *G lamblia* and *E histolytica*. Tinidazole is similar to metronidazole, but has a much longer half-life, and is given as a single large dose daily. Until recently, a single dose of 2 grams of tinidazole was recommended to eradicate *G lamblia*. A growing number of treatment failures has led us to recommend tinidazole 2 gms per day for two consecutive days to treat Giardiasis.

*E histolytica* infection is treated easily in Nepal with tinidazole 2 grams per day for 3 consecutive days, followed by diloxanide furoate (furamide) 500 mg TID for 10 days. In North America, metronidazole is used in heroic doses, 750 mg TID for 10 days. Ill effects from the metronidazole are universal during this course of treatment. The question of whether to treat *E histolytica* when it is found in the stool of people who are not ill remains problematic. *E histolytica* can be shed harmlessly in the stool by many individuals, and it is not clear whether these people are at risk for future intestinal or extraintestinal infections. By analyzing the pattern of enzyme electrophoresis, at least 40

different strains of *E histolytica* have been identified, of which about half are thought to be pathogenic. Thus, *E histolytica* cysts found in the stool of healthy individuals may represent a non-pathogenic strain that is not at risk of eventually causing illness. The full story of this particular pathogen remains to be told.

My approach to amoebiasis is to treat anyone who is symptomatic. It is rare for us to look at the stools of people who are not symptomatic, so we usually treat *E histolytica* when we find it. However, in the rare individual who has the organism and no symptoms, there is suggestive evidence that treatment might not be of any advantage.

The following table summarizes this section:

**The Three Major Treatable Types of Diarrhea**

Bacterial pathogen	Norfloxacin 400mg BID x 1-3 days <i>or</i> Ciprofloxacin 500mg BID x 1-3 days
<i>G lamblia</i>	Quinacrine 100mg TID x 5-7 days <i>or</i> Tinidazole 2000 mg as a single dose on two consecutive days
<i>E histolytica</i>	Tinidazole 2000mg as a single dose on three consecutive days, followed by Diloxanide furoate (Furamide) 500 mg TID x 10 days
<i>Cyclospora</i>	Trimethoprim-sulfamethoxazole 160mg and 800 mg twice a day for 7 days

## V. Symptomatic Treatment

For many years travelers have relied on antimotility drugs, such as diphenoxylate hydrochloride (Lomotil) and loperamide (Imodium), to control the symptoms of diarrhea until the self-limited infection runs its course. These days, loperamide seems to be favored over diphenoxylate, but both drugs are used with more caution. Prolongation of symptoms in people who have invasive bacterial diarrhea is considered a theoretical risk. We see people getting distended bowel, and increased discomfort in some cases, and prolonged constipation also occasionally occurs. Effective antibiotic treatment of bacterial diarrhea can make people asymptomatic within a day, whereas untreated bacterial infections can last for several days up to 2 weeks. I recommend that diarrhea severe enough to make you want to use an antimotility agent should be simultaneously treated with an antibiotic. Antimotility drugs should be carried, and used when travel is required within hours of the new onset of severe diarrhea. What else can you do when you wake up at 5:00 a.m. with severe diarrhea, and have to ride a bus for the next 12 hours?

Vomiting associated with bacterial diarrhea is a potentially serious problem, since it adds to dehydration and prevents efforts at rehydration. We have never seen severe dehydration in adults who had diarrhea but not vomiting. Vomiting almost always occurs

at the beginning of bacterial diarrhea, usually lasting only 6-12 hours. However, you must remember that even one episode of emesis can be incredibly uncomfortable; it's hard to imagine, unless it has happened to you, spending an entire night sitting on a toilet with crampy diarrhea, and vomiting into a bucket in front of you. Rarely, vomiting and diarrhea persist together for 4 or 5 days, resulting in individuals who are quite dehydrated and miserable. They often have to be helicoptered out of the Himalaya in this condition. Recently, we noted the death of a previously healthy 52 year old tourist, apparently from severe diarrhea. This represents the first incident of a tourist dying from gastroenteritis in Nepal.

Vomiting also prevents taking an oral antibiotic to shorten the infection. There are currently no injectable drugs known to shorten the course of bacterial diarrhea. The only choice is to try to treat with an anti-vomiting drug until the person can retain the oral antibiotic (such as norfloxacin). Our experience has been that in the first several hours of vomiting associated with a bacterial diarrheal infection, it is almost impossible to stop the vomiting with an injection of an anti-vomiting agent. One runs the theoretical risk, as well, of making them hypotensive, possibly leading to a syncopal episode as they jump up from their bed with severe nausea on their way to the toilet to vomit. Anti-vomiting therapy appears to work most effectively right at the time that repeated, spontaneous vomiting is stopping. The patient feels weak and nauseated at that point, but one or two hours may have passed without having to vomit. An injection of promethazine, or prochlorperazine, or a suppository of either drug, can eliminate the threat of further vomiting, allowing norfloxacin to be taken, which will then shorten the diarrheal illness dramatically. One can also try an oral anti-vomiting agent at this point, but it could come up again.

We all know from our own experience that feeling so nauseated that you have to vomit is a terrible feeling, every minute of which feels like hours. Make sure that your patients who travel to developing countries have some strategy for dealing with vomiting when it inevitably occurs.

## VI. Summary

At the CIWEC Clinic we see a wide spectrum of clinical illness related to diarrheal disease, from people who are well but *thought* they saw some mucus in their stool, to people who have gone into acute tubular necrosis secondary to dehydration caused by prolonged vomiting and diarrhea. Travelers' diarrhea should be thought of as an infectious disease, like any other, with multiple etiologies and varying severity. Antibiotic treatment can vastly shorten the length of illness and the suffering associated with diarrhea, and, in adventure travel, can often make the difference between being able to complete the itinerary or not.

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Saturday, August 12, 1995

# TRAVELERS WITH FEVER

*Jay Keystone, MD, FRCPC*

**Fever in returning travellers**  
**J. S. Keystone, M.D.**

**Objectives:**

*At the conclusion of this lecture you will:*

1. be able to formulate a differential diagnosis for fever in a returned traveller
2. know what questions to ask to assess the causes of fever
3. be able to recognize and diagnose the most common tropical causes of fever
4. know when to refer patients to tropical medicine specialists and why the world needs such animals

## FEVER IN RETURNING TRAVELLERS

### **A** FEVER

#### 1. Etiology:

McGill Centre for Tropical Disease Series 1981-88 (N=587)

Disease	%
malaria	32
hepatitis	6
URTI	6
pyelonephritis	4
pneumonia	3
acute bronchitis	2
dengue	2
enteric fever	2
undiagnosed	25

#### 2. Approach to Diagnosis:

##### a) History

##### i) pre-travel preparation:

- a. immunizations (typhoid, yellow fever, hepatitis, rabies, meningococemia)
- b. malaria chemoprophylaxis (drug, dose, compliance, duration)
- c. medications

##### ii) travel history

- a. incubation period
- b. duration of exposure

##### iii) travel itinerary:

- a. countries visited/duration
- b. accommodation
- c. exposure history:
  - eating raw, undercooked or exotic foods:  
(enteric infections, hepatitis)
  - drinking untreated water, milk/cheese:  
(salmonellosis, shigellosis, hepatitis, brucellosis)

## 2. Approach to Diagnosis: (Cont'd)

- fresh water exposure:  
(schistosomiasis, leptospirosis)
- sexual contact:  
(syphilis, HIV, LGV, Hepatitis, gonococemia)
- insect bites:
  - a. mosquitos, malaria, dengue
  - b. ticks: typhus, borreliosis, tularemia, Congo-Crimean HF
  - c. reduviid bugs: Chagas'
  - d. tse tse flies: trypanosomiasis
- exposure/bites from animals:  
(rabies, Q fever, tularemia, borreliosis, VHF, plague)
- exposure to infection:  
(Lassa, Marburg, Ebola, hepatitis, typhoid)
- medications prescribed:  
(drug fever)

### b) Incubation periods for selected tropical diseases

Incubation Period	Infection
Short (<10 days)	arboviral infections typhus plague paratyphoid enteric bacterial pathogens hemorrhagic fevers
Intermediate (10-21 days)	malaria scrub typhus, Q fever, spotted fever group trypanosomiasis typhoid fever brucellosis leptospirosis



b) Incubation periods for selected tropical diseases (Cont'd)

Incubation Period	Infection
Long (>21 days)	viral hepatitis tuberculosis malaria visceral leishmaniasis amebic abscess filariasis schistosomiasis HIV

c) Fever history

- i. continuous: typhoid fever, typhus
- ii. remittent: TB, African trypanosomiasis
- iii. intermittent: malaria, TB
- iv. relapsing: *P. malariae*, dengue fever, relapsing fever (*Borrelia*)

d) Physical Examination (See Appendices I, II, III)

Conjunctival injection:	leptospirosis, arbovirus, Lassa fever
Rash:	dengue, typhoid, typhus, syphilis, gonorrhea, Ebola, brucellosis
Jaundice:	malaria, hepatitis, yellow fever, leptospirosis, relapsing fever
Lymphadenopathy:	kalar-azar, brucellosis, rickettsial infections, dengue, Lassa fever
Hepatomegaly:	amebiasis, malaria, typhoid, hepatitis, leptospirosis
Splenomegaly:	malaria, relapsing fevers, trypanosomiasis, typhoid, brucellosis, kala azar, typhus, dengue
Eschar:	typhus, borrelia, Crimean-Congo haemorrhagic fever
Hemorrhage:	Lassa, Marburg, Ebola, Crimean Congo HF, Rift Valley, dengue, yellow fever, meningococcemia, epidemic louse-borne typhus, Rocky Mountain spotted fever

### 3. Specific Etiologies:

#### a) African travel? (consider haemorrhagic fever)

- <3 weeks of return
- rural area
- contact with ill persons

#### b) "Flu-like" Fevers from the Tropics

DISEASE	AGENT	LP.(D)	GEOG.	S & S
Typhoid	S. typhi	2-60	W.W.	headache cough constipation abd. discomfort
Dengue	Dengue virus	2-7	W.W.	headache myalgia rash (5-7d)
Typhus	R. conori	3-10	E. Africa Asia	eschar rash

### 4. Diagnostic screen:

Investigation	Comment
• CBC/diff.	platelets, WBC
• malaria blood films	daily x 3
• LFT's	hepatitis
• blood (urine, stool)	enteric fever
• urinalysis	UTI
• serology (red top)	arbovirus, rickettsia

## 5. Malaria

### a) General

- fever from the tropics is "malaria" until proven otherwise.
- malaria is a medical emergency
- imported malaria (1991) P. vivax (43%; P. falciparum (46%; P. malariae (3%); P. ovale (2%); unknown (~5%)
- incubation period <2 mo: 95% of P. falciparum vs 55% of P. vivax.
- panic button criteria:
  - fever  $\geq 3$  d
  - onset < 2 months after exposure
  - anemia
  - non-immune

### b) Diagnosis

#### i) When to make blood films

- ideal is 12 hours after fever spike (between paroxysms)
- repeat in 12-24 hours if film negative and malaria is suspected.

#### ii) Types of films

##### 1. Thin Film:

Advantages - study of parasite morphology (speciation)

Disadvantages - misses light infections  
- time consuming (30 min.)

##### 2. Thick Film:

Advantages - concentrates RBS's (diagnosis)

Disadvantages - more difficult to interpret and speciate compact parasites

**NOTE: Thin films are better than no films at all!**

c) **Management:**

- no antimalarial drug (s) guarantees protection.
- P. falciparum malaria from chloroquine-resistant areas should be treated as though it were resistant.
- steroids contraindicated in cerebral malaria.
- with very high parasitemia, exchange transfusion may be life saving.
- watch for hypoglycemia in pregnancy and with quinine treatment.
- primaquine contraindicated in G6PD deficiency (blacks, Asians, Orientals and Mediterraneans).
- primaquine contraindicated for P. vivax malaria in pregnancy -- continue chloroquine prophylaxis.
- primaquine resistance (S.E. Asia and oceania): Rx with double dose of primaquine.
- Chloroquine-resistant P. vivax in Indonesia.

A. **Chloroquine sensitive malaria (all species)**

Drug	Adult Dose	Pediatric Dose
chloroquine phosphate 1 tablet (150 mg base = 250 mg salt)	600 mg base (1 gm) 300 mg in 6 hrs. then 300 mg daily x 2 days	10 mg/kg (max. 600 mg) 5 mg/kg in 6 hrs., then 5 mg/kg x 2 days

**PLUS in *P. vivax* and *P. ovale* only:**

Drug	Adult Dose	Pediatric Dose
primaquine phos.	15 mg base/d x 14 days	0.3 mg base/kg/d x 14 d.

B. Chloroquine resistant *P. vivax*

Drug	Adult Dose	Pediatric Dose
i. chloroquine as above plus primaquine	10 mg base/kg total over 14 days or 2.5 mg base/kg total over 48 hrs.	same as for adults
ii. halofrantrine	24 mg/kg in 12 hrs.	same as for adults

C. Uncomplicated chloroquine resistant *P. falciparum*

Drug	Adult Dose	Pediatric Dose
i. quinine sulphate	650 mg tid x 3 days	24 mg/kg/d in 3 doses x 3 days (base)
plus		
Pyrimethamine/ Sulfadoxine (Fansidar) (25 mg/500 mg)	3 tablets in a single dose	2-11 mos: 1/4 tab. 1-3 yrs.: 1/2 tab. 4-8 yrs: 1 tab. 9-14 yrs: 2 tab. > 14 yrs: adult dose
or		
Tetracycline	250 mg q.i.d. x 7 d.	5 mg/kg q.i.d. x 7 d.
or		
Clindamycin	900 mg t.i.d. x 3 d.	20-40 mg/kg/d in 3 doses x 3 d.
ii. Mefloquine	1-1.5 mg x 1 dose	15 mg/kg x 1 dose
iii. Atovaquone	1 gm daily x 3 d plus doxycycline 100 mg bid x 3 d or proguanil 400 mg/d x 3 d	

iv. Halofantrine	500 mg t.i.d. x 1 day; repeat in 1 week	8 mg/kg t.i.d. x 1 day; repeat in 1 week
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**D. Treatment of severe illness, parenteral dose for all species**

Drug	Adult Dose	Pediatric Dose
Quinine		
loading:	20 mg/kg (salt) [1 mg salt = .83 mg base] in 300 ml N/saline IV over 2-4 hrs. Maintenance: 10 mg/kg Q8h.	Same as for adults
Quinidine		
loading:	24 mg/kg (salt) in 300 ml of N/saline IV over 2-4 hours. Maintenance: 12 mg/kg Q8H	Same as for adults

**OR**

10 mg/kg (salt) IV over  
1-2 hours. Then constant  
infusion of 0.02 mg/kg/min.  
by infusion pump.

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J.S. Keystone, M.D.  
June, 1995

## Appendix I

**Table 4. Frequency of Physical Findings in Some Febrile Illnesses**

Disease	Incubation period (days)	Hemorrhage and/or petechiae	Diarrhea	Rash	Splenomegaly	Lymphadenopathy	Jaundice	References
Malaria ( <i>falciparum</i> )	5-42	rare	18-29	0-5	24	3	6	17, 29, 55
Kala-azar (early)	10-120 months	8	28-55	0	79-100	0-86	2-7	25, 26, 54
Amebic liver abscess		-0	14-66	0	0-17	-0	10-25	2, 34, 43, 53
African trypanosomiasis	7-120+	-0	-0	23-46	11-41	34-81	2	11, 15
S. American trypanosomiasis	> 7	-0		-50				25, 33, 44
Typhoid	5-21	5-21	30-57	5-56	39-65	10	-0	16, 20, 22, 37, 52
Leptospirosis	2-21	2-9	15	2-9	5	12-21	43-95	3, 19, 58
Louse-borne relapsing fever	4-18	40	0-47	0-8	34-77	0	34-46	7, 36, 39
Brucellosis	7-120+	-0-26	11-16	3	20-61	12-50	2-24	25, 40
Miliary tuberculosis		1-6	3-33	< 1	0-54	6-46	3	5, 30, 45, 56
Meningococcemia				80-90				25
Toxic shock syndrome			98	100				25, 42
Dengue (classical)	2-7		28	71			-0	24
Hemorrhagic dengue	2-7	100	6	57	6	41		12, 32
Marburg	3-9	25-50	75-100	75-100		25-50		25
Ebola	2-21	7-100	52-100	50-75	-0	4	2	25, 46, 47
Lassa	6-21	25-50	25-50	5-25	-0	25-50	-0	25, 27, 44
(HIV-1) acute retroviral syndrome	7-42	0		25-50		36-58		25, 35
Tick typhus	5-7	-0	7-10	67-99	6-19	20-51	0	13, 28
Scrub typhus	6-18	-0	21	34	43	85	1	4, 12
Rocky Mountain spotted fever	2-14		19-20	87-95	14-16			12, 25
Louse-borne typhus	5-23	0-33	7	35-94	13-90	5	5	44, 51

Percentages represent one or more major clinical studies. Most studies look only at sicker hospitalized patients with increased pathology. Dark skin, immunity, age, nutrition, duration of illness before treatment, and other factors will greatly alter the frequency of physical findings in different study populations. The designation -0 = "probably zero," as specific findings are not mentioned in major studies. Absence of any figure indicates a lack of clarity in the major studies.



## Appendix II

**Table 6. Tropical Pathogens Associated with Lymphadenopathy**

Viruses	Localized	Generalized
Dengue		+
HIV		+
Hepatitis B		+
Lassa fever		+
Herpes simplex	+	
<i>Rickettsia</i>		
<i>R. conorii</i> (Boutonneuse fever)	+	
<i>R. tsutsugamushi</i> (scrub typhus)	+	+
<i>Chlamydia</i>		
<i>C. trachomatis</i> , LGV types	+	+
<i>Bacteria</i>		
Mycobacteria	+	+
<i>Treponema pallidum</i>	+	+
Leptospira		+
Brucella		+
<i>Yersinia pestis</i> (plague)	+	
<i>Pseudomonas pseudomallei</i> (melioidosis)	+	+
<i>Fungi</i>		
<i>Paracoccidioides brasiliensis</i>	+	+
<i>Parasites</i>		
<i>Leishmania</i>	+	+
<i>Trypanosoma</i>	+	+
<i>Wuchereria</i>		+

Adapted from: reference 25.

# Appendix III

**Table 7. Fever with Spontaneous Bleeding — Viral Hemorrhagic Fevers**

Pathogen	Incubation Period (days)	Geographic Distribution	Reservoir	Usual mode of transmission	Person-to-person spread	Sensitivity to Ribavirin
<b>Arenaviruses</b>						
Lassa	6-21	West Africa	Rodents	Aerosols	Yes	Yes
Argentinian (Junin)	7-12	Argentina	Rodents	Aerosols	No	Yes
Bolivian	7-12	Bolivia	Rodents	Aerosols	Yes (?)	Yes
<b>Bunyaviruses</b>						
Crimean-Congo	2-9	Africa, Asia, Eastern Europe, Mediterranean	Various large and small mammals	Ticks	Yes	Yes
Rift Valley fever	3	Africa	Various mammals	Mosquitoes	No	Yes
Hantaan viruses	9-35	Asia, Europe, Africa	Rodents	Aerosols	No	Yes
<b>Filoviruses</b>						
Marburg	3-9	Central or East Africa	Monkeys (?)	1) Contact with animal blood 2) Sexual	Yes	No (?)
Ebola	2-21	Africa, Phillippines (?)	Monkeys (?)	Unknown	Yes	No
<b>Flaviviruses</b>						
Dengue	2-7	Africa, Asia, America	Monkeys	Mosquitoes	No	No
Yellow fever	3-6	Africa, America	Monkeys	Mosquitoes	No	No

## Other Infections Associated with Bleeding

Meningococcemia	Relapsing fever due to <i>Borrelia recurrentis</i>	Atypical measles
Severe septicemia with gram-positive or gram-negative bacteria	Louse-borne typhus	Varicella ( <i>Purpura fulminans</i> )
Leptospirosis	Rocky Mountain spotted fever	Brazilian hemorrhagic fever due to <i>Haemophilus influenzae</i> biogroup <i>aegyptius</i>

References: 1, 6, 10, 14, 18, 21, 23, 31, 41

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Saturday, August 12, 1995

**TRAVELERS WITH  
UNDERLYING DISEASE**

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## Travelers with Underlying Disease

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Travelers with underlying disease need special consideration while planning for international trips. Preventive measures against travel-related illness, selecting contents of the travel medical kit, and planning for medical needs during travel are part of pre-travel preparation.

Medical Condition	Vaccines	Malaria	Diarrhea	Travel Advice
Allergy	x		x	x
Regular Medications	x	x	x	x
Immune Status-HIV	x		x	x
Immunosuppression	x		x	x
Diabetes	x		x	x
Neuro/psychiatric	x	x		x
Pacemaker		x		x
Cardiovascular	x	x	x	x
Pulmonary	x			x
Hemodialysis	x		x	x
Liver disease		x	x	x

### ALLERGY

#### 1) Vaccines--

Eggs--- caution: yellow fever, influenza, typhus vaccines\*\*

Hymenoptera (beesting) allergy-- caution: Japanese encephalitis vaccine

Vaccine components-- trace amounts of neomycin, polymyxin B, streptomycin, aluminum hydroxide, aluminum phosphate, thimerosal, formaldehyde, phenol, various dyes, various proteins\*\*

#### 2) Malaria

Chloroquine-- may exacerbate psoriasis

Chloroquine-- associated with pruritis in African Americans

Sulfa drugs-- contraindicated: Fansidar (sulfadoxine + pyrimethamine)

Tetracycline-- contraindicated: doxycycline

#### 3) Diarrhea

Sulfa drugs-- contraindicated: trimethoprim/sulfamethoxazole (Bactrim, Septra) for treatment of traveler's diarrhea

#### 4) Travel Advice

General advice-- wear a Medic Alert bracelet\*\*

Penicillin- include a non-penicillin antibiotic for strep throat, respiratory, and skin infections in travel medicine kit

Sulfa drugs-- contraindicated: acetazolamide (Diamox) for high altitude illness

Hymenoptera (beesting) allergy-- include epinephrine emergency injection and antihistamines in travel medicine kit.

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### CURRENTLY ON PRESCRIBED MEDICATIONS

#### 1) Vaccines

Antibiotic therapy (for example, daily doxycycline for acne)-- interferes with efficacy of oral typhoid vaccine Ty 21a.  
Chloroquine phosphate (Aralen) or chloroquine sulfate (Plaquenil)-- interferes with efficacy of intradermal rabies vaccine series.  
Mefloquine (Lariam)- may interfere with efficacy of the intradermal rabies vaccine series.

#### 2) Malaria

Antiseizure medications, coumadin, cyclosporine-- limited studies on drug-drug interactions. Mefloquine (Lariam) may influence blood levels. Start mefloquine 3-4 weeks prior to departure, and monitor therapeutic blood levels of regular medications or prothrombin time as appropriate.  
Quinine or Quinidine-- do not use mefloquine concurrently

#### 3) Diarrhea

Diuretics-- consider temporary cessation of dose during acute bout of severe watery diarrhea

#### 4) Travel Advice

Carry an adequate supply of all medications in the hand-held luggage, not in checked luggage.

Carry a copy or list of all prescribed medications and doses, and the name, telephone number, and fax number of regular physician at home

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### IMPAIRED IMMUNE STATUS- HIV & IMMUNE SUPPRESSION DUE TO MEDICATION OR UNDERLYING CONDITION

#### 1) Vaccines

Live vaccines (yellow fever vaccine, oral polio vaccine, oral typhoid vaccine, BCG vaccine) generally contraindicated: possible exception = MMR.  
Vaccine-induced immunity may be sub-optimal due to altered immune response  
PPD skin test for tuberculosis detection may not be predictable

#### 2) Malaria

Standard advice; beware of drug-drug interactions between mefloquine and regularly prescribed medications

#### 3) Diarrhea

Travelers with underlying altered immune response may be susceptible to more severe illness from diarrheal disease-- *campylobacter*, *salmonella*, *cryptosporidium*, etc.

- 4) Travel Advice
  - Trip insurance (in case of need to change or cancel travel plans)
  - Advance planning for medical contingencies occurring during trip; access to health care may be limited in some foreign countries

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#### DIABETES, INSULIN-DEPENDENT

- 1) Vaccines
  - Immune response to some vaccines may be sub-optimal
- 2) Malaria
  - Standard advice
- 3) Diarrhea
  - Infectious diarrhea may alter diabetic control, and contribute to fluid and electrolyte imbalance
- 4) Travel Advice
  - Adjust insulin dose according to published tables for eastward (shortened day) and westward (longer day) travel across multiple time zones\*
  - Pack extra snacks in the hand-held luggage, in case of delays, inedible airline food, and/or arrival after customary meal time in destination country (no food or beverages available for purchase at time of arrival).
  - Take along adequate supply of sterile insulin, syringes, and needles, along with prescription from physician.
  - Carry the name, telephone number, and fax number of regular physician at home.

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#### NEUROLOGIC CONDITIONS

#### PSYCHIATRIC CONDITIONS

- 1) Vaccines
  - Risk assessment for proposed itinerary to avoid unnecessary immunization in travelers with history of Guillain- Barre syndrome or multiple sclerosis
- 2) Malaria
  - Mefloquine may exacerbate underlying anxiety, depression, restlessness, confusion, and emotional disturbances.
  - Patients taking mefloquine while taking valproic acid (Depakene) had loss of seizure control and lower than expected valproic acid levels.
  - Patients concurrently taking antiseizure medication and mefloquine should have the blood level of their antiseizure medication monitored and the dosage adjusted appropriately.
- 3) Diarrhea
  - Standard advice

- 4) Travel Advice  
Travel may be a stressful experience to some travelers who are dealing with unresolved personal issues. Companions and trip leaders need to be on the alert for subtle signs of worsening moods, personality changes, and suicide attempts.
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**CARDIAC PACEMAKER**

- 1) Vaccines  
Recommend current viral influenza vaccine  
Check pneumococcal vaccine status
- 2) Malaria  
Mefloquine not recommended for persons with significant underlying cardiac disease resulting in conduction abnormalities
- 3) Diarrhea  
Standard advice
- 4) Travel Advice  
Pre-travel evaluation by regular physician  
  
Copy of the electrocardiogram with and without the pacemaker activated  
  
Pacemaker identification code form from the American Heart Association  
  
Name of physician or medical center in the destination country for consultation in case of suspected malfunction
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**CARDIOVASCULAR DISEASE**

- 1) Vaccines  
Recommend current viral influenza vaccine  
Check pneumococcal vaccine status
- 2) Malaria  
Mefloquine not recommended for persons with significant underlying cardiac disease resulting in conduction abnormalities
- 3) Diarrhea  
See section on MEDICATIONS above
- 4) Travel Advice\*\*  
Carry an adequate supply of all medications in the hand-held luggage, not in checked luggage.  
  
Carry a copy or list of all prescribed medications and doses, and the name, telephone number, and fax number of regular physician at home  
  
Carry a copy of current electrocardiogram

Allow plenty of time for travel to the airport, airport parking, standing in line at the ticket-counter to check in, and passage through security checks to get to the departure gate.

Request in advance, at the time the ticket is booked, an aisle seat for increased mobility and leg room.

Request in advance, at the time the ticket is booked, supplemental oxygen for in-flight use, and for layovers in high-altitude airports.

Request special in-flight meals in advance, at the time the ticket is booked.

Request assistance by wheelchair or airport motor cart for transport within the airport terminal if there are problems with ambulation, exercise tolerance, or any other disabilities.

Pack lightly, and utilize luggage with wheels or a baggage cart for transport of carry-on bags within the terminal.

Trip insurance (in case of need to change or cancel travel plans)

Advance planning for medical contingencies occurring during trip; access to health care may be limited in some foreign countries

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#### PULMONARY DISEASE

1) Vaccines

Recommend current viral influenza vaccine

Check pneumococcal vaccine status

See section on IMMUNOSUPPRESSION if on steroid treatment

2) Malaria

Standard advice

3) Diarrhea

Standard advice

Stay well-hydrated

4) Travel Advice\*\*

A given cruising altitude of 35,000 ft above sea level will result in a cabin altitude varying from 5,000 to 8,000 ft among different airlines according to various pressurization schedules.

Supplemental oxygen for air travel should be considered for people with a baseline PO<sub>2</sub> of 70 mm Hg or less at sea level.



Order supplemental oxygen for in-flight use, and also layovers, transfers, or even arrival at final destination if intermediate and final ground stops are more than 5,000 ft above sea level

Supplemental oxygen must be ordered, usually with a physician's prescription, at least 48 hr in advance of departure, and at an extra charge.

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## HEMODIALYSIS

### 1) Vaccines

Vaccine-induced immunity may be sub-optimal due to altered immune response (*Hepatitis B vaccine, Hepatitis A vaccine*)

### 2) Malaria

Standard advice

The pharmacokinetics of mefloquine in patients with compromised renal function have not been studied

### 3) Diarrhea

Standard advice

Stay well hydrated

### 4) Travel Advice

Make special arrangements for hemodialysis at destination(s)

Consult American Association of Kidney Patients or

International Directory of Dialysis Centers\*\*

Trip insurance (in case of need to change or cancel travel plans)

Advance planning for medical contingencies occurring during trip; access to health care may be limited in some foreign countries

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## LIVER DISEASE

### 1) Vaccines

Standard advice

### 2) Malaria

Mefloquine is essentially completely metabolized through the liver

Transient elevation of transaminases may occur during prophylactic administration of mefloquine

Periodic evaluation of hepatic function should be performed during prolonged mefloquine prophylaxis

The pharmacokinetics of mefloquine in patients with compromised hepatic function have not been studied

### 3) Diarrhea

Avoid eating raw or undercooked oysters, clams, mussels, and seafood because of increased susceptibility to sepsis from *Vibrio vulnificus* infections\*\*

- 4) Travel Advice  
Trip insurance (in case of need to change or cancel travel plans)  
Advance planning for medical contingencies occurring during trip; access to health care may be limited in some foreign countries
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